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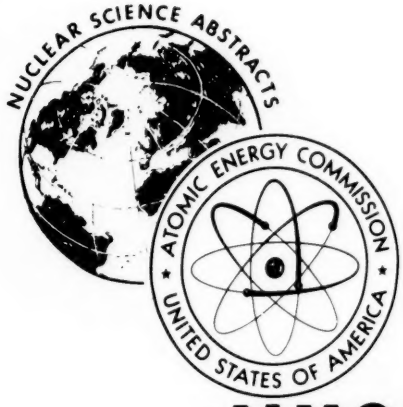

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Volume 20, Number 14, July 31, 1966

NUCLEAR SCIENCE ABSTRACTS

BIOLOGY AND MEDICINE

General

24829 (NEIC-RR-17) RAPORT Z PRAC BADAWCZYCH PROWADZONYCH W 1964 ROKU. (Annual Report on the Research Work of the Institute for 1964). Jasinskiego, W. (Instytut Onkologii, Warsaw (Poland)). 1965. 197p. Dep. CFSTI $5.00 cy, $1.00 mn.

Research is reported in experimental oncology in which cytogenetic investigations related to the creation of pure genetic lines of malignant cells were based on the isolation of Ehrlich ascites tumor grafted on newly born mice; immunological reactions were examined by transplanting individual clones into normal and thymectomized rats. Studies on hormone action mechanisms revealed that cultures of mammary glands, vaginal epithelium, and seminal vesicles exhibit better growth when supplemented with sex hormones. Pathological studies were centered on raising the level of histopathological diagnosis, examination of the mammary carcinoma, pathomorphology of cancer of the stomach, gastric mucosa, and uterine cervix. Immunoelectrophoretic investigations were carried out on serum proteins and on the level of free amino acids in the blood and urine. In the field of x-ray therapy and ^{60}Co γ-radiation, changes in the isodose distribution of nonhomogeneous media were examined for treatment planning, studying specifically the dose distribution in an anatomic neck and head phantom, and also from Ra, ^{60}Co, ^{182}Ta, ^{192}Ir, and ^{198}Au applicators. Quantitative measurements were initiated for the application of ^{131}I in the diagnosis of thyroid diseases. A method was developed for the mathematical analysis of the kinetics of the Ca turnover in humans. In radiobiology, the therapeutic effect of nucleic acids in radiation sickness was examined, finding that only preparations made from the liver of young animals of the same strain increased the survival rate of animals subjected to lethal doses. (TTT)

24830 ACTION OF AMINOETHYLISOTHIURONEUM. HBr(AET). DISTRIBUTION OF RADIOACTIVITY FOLLOWING AET-^{35}S ADMINISTRATION AND OPTIMUM ADMINISTRATION TIME OF AET. Katayama, Hitoshi (Kyushu Univ., Japan). Nippon Acta Radiol., 25: 124-36 (May 1965). (In Japanese).

The distribution of radioactivity following the administration of sulfur-35-labeled AET in tumor-bearing mice and rats and the optimum time of AET administration were investigated. Radioactivity was maximum at 30 minutes after AET administration in the kidneys, spleen, liver, large intestine, sternum, femur, and testes. The optimum administration time of AET was 30 minutes before irradiation by corrected administration time. (TCO)

Ecology

24831 (RLO-1731-5) TAGGING STUDIES TO DETERMINE THE OFFSHORE-INSHORE EXCHANGE OF GROUNDFISH OFF OREGON AND WASHINGTON. Final Report, June 1961–February 1966. Milburn, Gary S. (Oregon Fish Commission, Astoria). Feb. 1966. Contract AT(45-1)-1731. 35p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

A cooperative study was initiated in June 1961 by the Atomic Energy Commission, Bureau of Commercial Fisheries, and Oregon Fish Commission to determine the offshore-inshore movements of Dover sole and sablefish. During the period from June 1961 to May 1964, 9,013 Dover sole and 4,647 sablefish were tagged and released at approximately 25-fathom intervals from 50 to 450 fathoms in a 35-mile-long area southwest of the Columbia River. Tagged fish were brought in as part of the catch of the commercial trawlers. Returns of tagged Dover sole show a northeasterly and inshore movement during the late spring and early summer. An opposite movement to offshore areas is shown during the late fall and early winter. A higher recovery rate was found for Dover sole tagged in shallow water than for those tagged in deeper areas. Two factors appear to explain this differential recovery rate: the fishery is most intense in the shallow areas during the summer; and most of the deep-water tagged fish were males and the males do not move as far inshore as do the females. No difference in availability of deep-water tagged fish and those tagged in shallow water could be attributed to size. (auth)

24832 (TID-22872) RADIOACTIVITY TRANSPORT IN WATER: SORPTION AND RELEASE OF RADIONUCLIDES BY SEDIMENTS OF THE GUADALUPE RIVER. Technical Report No. 6. Clanton, U. S.; Bradley, W. F.; Gloyna, E. F. (Texas Univ., Austin. Environmental Health Engineering Research Lab.). July 1, 1964. Contract AT(11-1)-490. 74p. (EHE-10-6404). Dep. mn. CFSTI $3.00 cy, $0.75 mn.

The sorption of cesium-137 and strontium-89 by sediments in fluvial and lagoonal environments in a climate and topography characteristic of the Southwestern United States was investigated. Contemporary sediment samples from preselected locations in the Guadalupe River drainage basin were analyzed for their mineral composition, ion exchange capacity, and radionuclide-sorption. The most significant mineral assemblage in radionuclide sorption was the clay minerals. X-ray diffraction patterns of the clay-sized particles showed the presence of a heterogeneous mixed-layered clay mineral complex of poor crystallinity. Ion exchange capacity measurements gave values of 10 to 47 meg/100 grams and projected values of 20 to 73 meg/100 grams of clay material. Radionuclide sorption studies using cesium-137 and strontium-89 were made on naturally occurring sediments and sediments from which the organic fraction had been removed. Radionuclide sorption or release was highest during the first few moments of contact but slowly continued to increase throughout the seven day duration of the experiments. The results indicated that radionuclide sorption in the dynamic fluvial en-

vironment was temporary. When the contaminated sediments were placed in conditions simulating a marine environment, 43 per cent of the cesium-137 and 42 per cent of the strontium-89 were released because of the competition from the more abundant ions in sea water for the exchange sites. (P.C.H.)

24833 (TID–22877) RADIOACTIVITY TRANSPORT IN WATER—TRANSPORT OF ^{85}Sr AND ^{137}Cs IN AN AQUATIC ENVIRONMENT. Technical Report No. 10. Shih, Chia-Shun; Gloyna, Earnest F. (Texas Univ., Austin. Environmental Health Engineering Research Lab.). Jan. 20, 1966. Contract AT(11-1)-490. 110p. (EHE–01-6602; CRWR–10). Dep. mn. CFSTI $4.00 cy, $0.75 mn.

The transport of two radionuclides, ^{85}Sr and ^{137}Cs, was observed in a model river containing lake sediments, typical rooted plants, and suspended plankton. Measurements of uptake and release of these radionuclides in aquatic systems following a single release were conducted at various locations and times during 120 days. In support of these radionuclide transport data, measurements were also made of pH, oxidation-reduction potential, dissolved oxygen, temperature, total and filtered light intensity, carbon dioxide, biomass geochemical analyses, and flow. The results describe the relative uptake and transport by the components of the flume system. Graphical techniques were developed to describe the distribution of radionuclides in the liquid phase and analytical expressions were obtained to relate the measured detention to the amounts of plants, sediments, and suspended solids. (auth)

24834 (TID–22878) RADIOACTIVITY TRANSPORT IN WATER. THE TRANSPORT OF ^{58}Co IN AN AQUEOUS ENVIRONMENT. Technical Report No. 7. (Texas Univ., Austin. Environmental Health Engineering Research Lab.). Dec. 1, 1964. Contract AT(11-1)-490. 135p. (EHE–12-6405). Dep. mn. CFSTI $4.00 cy, $1.00 mn.

The ecological environment of a river system was simulated with the aid of a specially adapted research flume. The characteristic transport of radioactive cobalt was evaluated by measuring the depletion of ^{58}Co in a plume resulting from the instantaneous release of $CoCl_2$. The residual effects of the plume were monitored for 90 days. The ecological analysis considered involved detailed evaluations of the detention characteristics exhibited by the bottom sediments, suspended solids, and biomass. From the accumulated and release data, detention coefficients were obtained for estimating the relative longitudinal transport of cobalt in an aqueous environment. In either the flowing or nonflowing ecosystem the greatest fraction of the ^{58}Co at a particular position in the stream remained in solution, although significant quantities were detained by the rooted plants, sediments, and suspended material. Laboratory and bench studies accompanied the larger flume studies. Various studies involving ion exchange, general sorption, and release were conducted with selected clays, fractions of bottom sediments, and typical biomass. (72 references). (auth)

24835 BEHAVIOR OF ^{90}Sr IN LAKE HARUNA, JAPAN. Hanya, Takahisa; Araki, Tadashi; Naka, Kazuko (Tokyo Metropolitan Univ.). pp 335-47 of Recent Researches in the Fields of Hydrosphere, Atmosphere and Nuclear Geochemistry. Miyake, Yasuo; Koyama, Tadashiro (eds.). Nagoya, Japan, Sugawara Volume, Nagoya Univ., 1964.

The relation between ^{90}Sr concentration in lake water and its deposition on the earth's surface and the relation of the ^{90}Sr content of biological materials in the lake with that of the water were studied. In the stagnation period ^{90}Sr concentration was found to vary beyond the measurement error with depth and location even for simultaneous sampling. The ^{90}Sr accumulation in the lake, as a whole, showed an increase from 1957 to a maximum in June 1959, and then a gradual decrease toward 1961. Another sharp increase was observed from 1961 to the summer of 1963. It was concluded that most ^{90}Sr in the lake water originates from direct fallout on the lake surface, that the ^{90}Sr content in the outflowing stream water is approximately equal to the average of the lake water, and that no appreciable amount of ^{90}Sr was deposited on the lake bottom. The ^{90}Sr to stable Sr ratio in annual aquated rooted plants was the same as that for lake water. The ratio for fish bone appeared to correspond to that of lake water of previous years. (M.C.G.)

Metabolism, Tissue Distribution, and Toxicology

Refer also to abstracts 24996, 25115, and 26549.

24836 (AE–224) CALCIUM AND STRONTIUM IN SWEDISH WATERS AND FISH, AND ACCUMULATION OF ^{90}Sr. Agnedal, P-O (Aktiebolaget Atomenergi, Stockholm (Sweden)). Apr. 1966. 34p. Dep. mn.

The correlation between Ca and Sr uptake in fish in relation to the concentration of these elements in the water was investigated. A study was made of the uptake of ^{90}Sr and permissible levels of ^{90}Sr in the water was calculated, based upon the uptake in fish muscle tissues. Lakes with Ca concentrations between 2 to 63 mg/l were studied with emphasis on samples from the Baltic coastal water. Three fish species studied included pike (Esox lucius), perch (Perca fluviatilis), and roach (Leuciscus rutilus). Bones, muscle tissues, and skin + scales were analysed. Strontium-90 measurements showed an increase in both water and fish between 1960 and 1966. Calculations showed that in water with about 2 mg Ca/l a 10-fold increase of the existing ^{90}Sr level might give ^{90}Sr concentrations in fish muscle tissues close to permissible levels. In lakes with calcium concentrations 20 to 40 mg/l the permissible levels for drinking water will be exceeded before the fish consumption would have to be restricted. (auth)

24837 FALLOUT ^{90}Sr AS A METABOLIC TRACER. Harley, John H. (Atomic Energy Commission, New York). Arch. Environ. Health, 12: 578-82(May 1966).

Studies using ^{90}Sr as a metabolic tracer are reviewed. Such investigations include sampling and ^{90}Sr analysis of human diet and of autopsy specimens of human bone. An empirical model for the metabolism of ^{90}Sr is presented and is applied to data from a dozen adult accident victims. Turnover rates of 4% for the shaft of long bones, 5% for rib, and 9% for vertebrae were obtained. (H.G.D.)

24838 ASEPTIC AUTOLYSIS WITH CONTINUOUS DIALYSIS OF RAT THYROID GLANDS LABELLED WITH RADIOACTIVE IODINE. II. IODINATED AMINO ACID COMPOSITION OF IODOPEPTIDES FORMED DURING AUTOLYSIS AND LIBERATION OF HORMONES. Lissitzky, Serge; Benabdeljlil, Claude (Faculte de Medecine et Pharmacologie, Marseille). Bull. Soc. Chim. Biol., 47: 655-68(1965). (In French).

Adult male Wistar rats were used to study distribution of radioiodine in various thyroid fractions. The dialysable iodopeptides liberated by aseptic autolysis at 37° and pH 3.6 of thyroid glands in isotopic equilibrium conditions with ^{125}I of rats sacrificed after injection of a tracer dose of ^{131}I were studied. Their iodinated amino acid composition and specific activity were compared with that of other iodinated constituents of the gland. Like the iodopeptides present in the physiological stage in the iodinated dialysable fraction of the thyroid, none of them contain iodothyronines liable to be liberated through pronase digestion. The thyroid hormones are liberated by proteolysis directly in a free form while the iodoproteins are liberated under various molecular forms, i.e., as iodinated amino acids or free iodopeptides. From 16 hr after injection of radioiodine, the iodotyrosines that can be liberated from iodopeptides by pronase digestion have a much higher specific activity than that of the other iodinated amino acids of dialysable or nondialysable fractions. (BBB)

24839 COMPARISON OF THE TISSUE DISTRIBUTION OF ^{59}Fe IN THE MALE RAT ACCORDING TO THE INTRAVENOUS OR INTRAGASTRIC INJECTION METHOD AND ACCORDING TO THE PROTEIN CONCENTRATION

OF THE DIET. Aschkenasy, A. CNRS-ERSI, Montrouge, France). Compt. Rend. Soc. Biol., 159: 1886-90(1965). (In French).

The uptake of ^{59}Fe by the bone marrow, the blood, the spleen, and the liver in the male rat is much greater after intravenous than after intragastric introduction of the isotope. The ^{59}Fe is almost completely unutilized for erythropoiesis in the initial phase when the diet is deficient in proteins. Nevertheless the total intestinal absorption of the isotope is not below normal when the diet is deficient. The fraction of ^{59}Fe injected intravenously and excreted by the digestive system is higher when the diet is deficient in proteins than when the animals are on a balanced diet. (tr-auth)

24840 METHOD OF DETERMINING ^{228}Ra IN THE HUMAN BODY BY EXAMINING EXCRETIONS. Malykhin, V. M.; Shamov, V. P.; Reznik, G. S. Gig. Sanit., 2: 58-61(Feb. 1966). (In Russian).

A graduated model was developed for determining the elimination of ^{228}Ra and ^{228}Th and its decay products by measuring the activity of the feces. Counting of ^{228}Ra is complicated by the presence of its daughters ^{228}Th, ^{224}Ra, ^{220}Rn, ^{216}Po, ^{212}Bi, ^{212}Pb, which contribute to the bone tissue dose. In view of the fact that the short-lived decay products of ^{228}Th are in equilibrium with the parent, a formula was developed to determine the dynamic equilibrium conditions of ^{228}Ra and ^{228}Th. The graphs obtained allowed the content and internal dose due to these elements in organism to be estimated by measuring the activity of the excretions, as a function of the duration of treatment with ^{228}Ra. When used in conjunction with an in vivo method, the graphs presented make it possible to calculate the coefficient of emission of ^{220}Rn from the bone tissue, as the difference between the in vivo activity of ^{208}Tl, measured on the basis of the 2600-kev γ line, and the ^{228}Th activity of the skeleton, calculated from the activity of the feces, corresponds to the emanation of ^{220}Rn. The sensitivity of the method based on the measurement of the excretion varies from 1×10^{-8} to 5×10^{-13} C. (TTT)

24841 LYMPHATIC SYSTEM—A STOREHOUSE OF LONG-STAY DEPOSITS OF INHALED RADIOACTIVE PARTICLES. Oliver, R.; Watson, Shane (Churchill Hospital, Oxford). Health Phys., 12: 720(May 1966).

The importance of the lymphatic system in transporting and filtering radioactive material within the body is considered. It has been shown that particles can be absorbed in the lung and transported via the lymphatic system to form long-term deposits elsewhere in the body. Apart from the local effect of irradiation from such active deposits, it may be of some biological significance that lymph nodes are sites for the formation and processing of lymphocytes for the circulation and the tissues. Another lymphatic mechanism that must be considered in evaluating inhalation hazards are the chylomicrons. (H.G.D.)

24842 ELECTRON MICROSCOPE STUDIES ON THE ACTIVE ACCUMULATION OF Sr^{2+} BY RAT-LIVER MITOCHONDRIA. Greenawalt, John W.; Carafoli, Ernesto (Johns Hopkins School of Medicine, Baltimore). J. Cell Biol., 29: 37-61(Apr. 1966).

Electron-opaque granules are deposited in isolated rat liver mitochondria concomitant with the energy-linked accumulation of Sr^{2+} by these organelles. High temperature microincineration (600°C) of thin sections of mitochondria containing different amounts of Sr^{2+} shows that a clear qualitative correlation exists between the number of inorganic residues remaining after incineration and the amount of Sr^{2+} translocated into the mitochondria. By loading the mitochondria with consecutive pulses of small amounts of Sr^{2+} (multiple-pulse loading), very early stages of granule formation can be detected; the first detectable deposits are seen closely associated with the cristae. The evidence presented supports the hypothesis that mineral deposition following or during the in vitro accumulation of ions by mitochondria occurs, at least initially, at sites on these membranes and not as nonspecific precipitates in the mitochondrial matrix. The large number of electron-opaque deposits (100 to 200) seen in single thin sections of individual mitochondria having accumulated intermediate levels of Sr^{2+} clearly exceeds the number of normal dense granules in rat liver mitochondria, indicating that the normal matrix granules per se do not constitute sites essential for deposition. At the highest levels of Sr^{2+} uptake studied in the multiple-pulse loading experiments, needle-like deposits are seen, a result which suggests that the structural form (crystallinity) of the mineral deposits may be determined by the rate of accumulation. (auth)

24843 INFLUENCE OF COLD ON THYROID UPTAKE OF ^{131}I AND CIRCULATING IODINE COMPOUNDS. Salvaneschi, J. P.; Altschuler, N.; Enriori, C. (Centro de Endocrinologia, Buenois Aires). Nature, 209: 1240-1(Mar. 19, 1966).

Experiments on rats showed that cold (2 to 6°C) had no effect on the thyroidal uptake of ^{131}I when cold exposure was limited to 2 hr but a significant decrease was noted when cold exposure was 24 hr duration; animals exposed to cold for both 2 hr and 24 hr showed a significant decrease in thyronine fraction; PB ^{127}I values were not statistically different in the 2 groups. (C.H.)

24844 BIOLOGICAL INDICATOR OF ^{54}Mn CONTAMINATION IN TERRESTRIAL ENVIRONMENTS. Cavalloro, Raffaele; Ravera, Oscar (EURATOM Joint Nuclear Research Center, Ispra, Italy). Nature, 209: 1259(Mar. 19, 1966).

A comparison was made of ^{54}Mn uptake by the red slug, Arion rufus, and the freshwater mollusk Unio mancus from Lake Maggiore. It is suggested that Unio may be used as an indicator of ^{54}Mn contamination in freshwater environments and Arion may be used as an indicator of ^{54}Mn contamination in terrestrial environments. (C.H.)

24845 DISTRIBUTION OF ^{137}Cs IN THE HUMAN ORGANISM AND IN THE HUMAN FOETUS. Kaul, A.; Nay, U.; Rajewsky, B.; Stahlhofen, W.; Unnewehr, F. (Max Planck-Institut fuer Biophysik, Frankfurt am Main). Nature, 209: 1310-12(Mar. 19, 1966).

The content of fission product ^{137}Cs was measured in samples of bone and soft tissues from deer and man of various age groups, including fetal and placental tissues. Results showed that the specific ^{137}Cs content of muscular tissue is about 15 times that of compact bone. The ratio in the stag was somewhat lower than that in man. The ^{137}Cs content in brain was about 25% that of muscular tissue and the content in liver was significantly lower than in muscular tissue. No change in the specific activity of ^{137}Cs in tissues as a result of age was found. A comparison of the specific activity of ^{137}Cs in relation to K in bone and soft tissues of adults and fetuses led to the conclusion that there is no significant placental discrimination for ^{137}Cs in the activity range studied. (C.H.)

24846 CLINICAL APPLICATION OF WHOLE BODY COUNTING. I. WHOLE BODY RETENTION OF ^{131}I IN PATIENTS WITH THYROIDAL DISEASE. Tateno, Midori (Chiba Univ., Japan). Nippon Acta Radiol., 25: 66-71 (Apr. 1965). (In Japanese).

A high level whole body counter has been used for more than one year, measuring the body retention of test and therapeutic doses of ^{131}I in patients. Patients were measured in supine and prone positions at the distance of 2m from the crystal, putting the patient within the complete visual field of collimator. The geometric mean of both counting values, supine and prone, are calculated and radioactive decay following the administration is corrected. The counting value at 2 to 3 hours after the oral administration of ^{131}I was calibrated at 100% retention, and during that time no excretion of radioisotope was observed. The whole body retention curves for therapeutic doses were similar to those of the test dose in most patients. But in a few patients there were some different curves of two types; one showing somewhat rapid decrease after the first 4 to 5 days, another showing a straight line, in a semi-logarithmic paper. In the latter two types, thyroid uptake increased rapidly after administration of ^{131}I. (TCO)

24847 STRONTIUM UPTAKE IN RATS ON ALGINATE-SUPPLEMENTED DIET. Harrison, George E.; Humphreys, Eric R.; Sutton, Alice; Shepherd, Hilda (Medical Research Council, Harwell, Eng.). Science, 152: 655-6 (Apr. 29, 1966).

Rats were fed a basic diet supplemented with sodium alginate and with tracer amounts of strontium-85 and calcium-45. Absorption of strontium was always inhibited by the alginate to a greater extent than absorption of calcium. Discrimination against strontium was greatest in alginate containing a high proportion of guluronic acid. (auth)

24848 EFFECTS OF IRRADIATION ON THE IRON UPTAKE OF LIVER CELLS IN VITRO. Adam, Geza; Miltenyi, Laszlo (Medical Univ., Debrecen, Hungary). Strahlentherapie, 129: 604-7(Apr. 1966). (In German).

The iron uptake of rat liver cells was investigated in vitro after whole body γ irradiation with different doses. A considerable increase in iron uptake was found after doses of 400 and 600 rad and after 90 minutes incubation time. This increased iron uptake is believed to be due not only to the damage of the bone marrow, but also to other factors. Further investigations with irradiated serum did not result in appreciable changes in the iron content of the liver cells. (auth)

24849 INVESTIGATIONS ON BIOLOGICAL RADIATION PROTECTION. PART 69. INFLUENCE OF HEAD IRRADIATION ON THE RADIOIRON INCORPORATION IN ERYTHROCYTES. Koch, Ruprecht; Seiter, Irma (Univ., Freiburg i. B.). Strahlentherapie, 129: 608-15(Apr. 1966). (In German).

The heads of mice were irradiated with 150, 600, 1600, and 10,000 R, respectively. The radio-iron incorporation into young erythrocyte populations were measured up to the 8th day after irradiation. Hematocrit values were determined before and after irradiation. The climbing test was used to study the behavior of mice irradiated with 10,000 R. Irradiation of the head up to 10,000 R had no influence upon the ^{59}Fe-incorporation into the young erythrocytes. Irradiation with 10,000 R resulted in a considerable and significant disturbance in the climbing ability of the animals. Hematocrit values are significantly decreased only after 600 and 10,000 R. (auth)

24850 UPTAKE OF ^{22}Na IN THE CELL NUCLEI OF THE SALIVARY GLANDS OF CHIRONOMUS THUMMI. Lezzi, Markus; Kroeger, Heinrich (Eidgenoessische Technische Hochschule, Zurich). Z. Naturforsch., 21b: 274-7(Mar. 1966). (In German).

The in vivo and in vitro uptake of ^{22}Na from the hemolymph into cell nuclei of larval salivary glands was measured and compared. The uptake of ^{22}Na in vivo follows approximately a saturation curve. The respective in vitro curve has a much steeper slope during the first 8 min and this phase is followed by an interval during which the ^{22}Na content of the nuclei decreases (8 to 16 min). After the 16th min it increases again to reach a nuclear ^{22}Na content approximately twice as high as that of nuclei in vivo at 60 minutes. The uptake curves are discussed in relation to recent findings on the induction of puffs in polytene chromosomes by inorganic ions. (auth)

24851 COEXISTING CALCITES AND ARAGONITES FROM SKELETAL CARBONATES OF MARINE ORGANISMS AND THEIR STRONTIUM AND MAGNESIUM CONTENTS. Lowenstam, Heinz A. (California Inst. of Tech., Pasadena). pp 373-404 of Recent Researches in the Fields of Hydrosphere, Atmosphere and Nuclear Geochemistry. Miyake, Yasuo; Koyama, Tadashiro (eds.). Nagoya, Japan, Sugawara Volume, Nagoya Univ., 1964.

Data are presented on the aragonite-calcite ratios of skeletal carbonates for species from the Hydrozoa, Octocorallia, and Cerripedia. The relations of their aragonite-calcite ratios to ecologic factors were examined. Sr and Mg contents were determined from coexisting calcites and aragonites. Data are presented in tables and graphs. It is shown that crystal chemistry constitutes a first order effect on Sr uptake in aragonites and calcites of Coelenterate, Bryozoa, Annelida, and Arthropoda. (M.C.G.)

Radiation Effects on Biochemicals

See also CHEMISTRY — Radiation Chemistry

Refer also to abstract 24909.

24852 (CEA-R-2922) EVOLUTION DE LA GLYCEMIE CHEZ LE RAT APRES IRRADIATION GAMMA. (Evolution of Glycemia in the Rat After Gamma Irradiation). Marble, Georges; Frossard, Henri; Breuil, Lucien; Engler, Robert (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Dec. 1965. 11p. Dep. mn.

The study of glycemia variations in the rat after irradiation has made it possible to observe not only a premature hyperglycemia but also a belated hypoglycemia whose importance and subsequent evolution seem to depend on the dose given to the animal. (auth)

24853 (CERN/HER/AP-1-66) SIMULATED COSMIC-RAY IRRADIATION WITH 600-Mev PROTONS. VOLUME TWO. FIRST PART. ELECTROPHORETICAL STUDIES OF BLOOD PROTEINS (MSC-1 AND MSC-2 EXPERIMENTS ON MICE). Pasinetti, Antonio (European Organization for Nuclear Research, Geneva (Switzerland). Milan Univ. (Italy). Istituto di Farmacologia e di Terapia). Feb. 1966. 100p. Dep. mn.

Serum proteins were studied in mice exposed to whole-body irradiation with the 600 Mev proton beam of the CERN synchrocyclotron. The animals were sacrificed by carotid incision at intervals of 1, 3, 7, 10, 15, 20, 25, 30, 45, 67, and 80 days post-irradiation. Blood serum separated by centrifugation was subjected to quantitative determination of the total proteins. Total proteins, lipoproteins, and glycoproteins were studied by electrophoretic methods. It was shown that a greater correlation exists between similar radiation doses than between different doses of the same type of radiation. (H.G.D.)

24854 RELATIONS BETWEEN THE KARYOTYPE AND THE RADIOSENSITIVITY OF CELLS IN VITRO. Mauersberger, B.; Krueger, K.; Cerny, M. (Humboldt Univ., Berlin). Acta Biol. Med. Ger., 15: 164-72(1965). (In German).

Possible correlation of the chromosome complement of mouse and human cells cultured in vitro with radiosensitivity was examined using 200-kv x rays in doses of 100, 300, and 500 R. Cultured L and HeLa cells having both normal and double the usual number of chromosomes were tested for their sensitivity to x rays using the single-cell technique of Puck. The lethality curves of both L and HeLa cells proved to be within the same regions, but did not coincide completely. Cells having both normal and double quantities of chromosomes showed the same sensitivity. However, significantly heavier damage of L II as compared to L I was observed after 500 R. These experiments revealed the absence of the ploidy effect in heteroploid cell cultures, contrary to results in plants. Chromosome analyses revealed numerous monosomic chromosomes which might be responsible for the absence of any increase in resistance to radiation with increased ploidy. (BBB)

24855 KINETICS OF THE IRON AND COPPER LEVEL IN THE SERUM FOLLOWING DIFFERENT DOSES OF TOTAL BODY IRRADIATION IN RATS. Schmitt, W.; Braun, H.; Coenen, J. (Universitatsklinik Luitpoldkrankenhaus, Wuerzburg, Ger.). Aerztl. Forsch., 19: 320-5 (June 10, 1965). (In German).

After single whole-body x irradiation with 20, 50, 100, 200, or 600 R the serum concentrations of Fe, Cu, and the latent and total Fe-binding capacities were measured in 170 rats. The periods chosen were 9, 72, 144 hr after irradiation. The serum Cu concentration varied in two phases over this time period. It increased from 142 to 386.8 μg% in animals that were irradiated with 600 R, but the increases were smaller in animals that received less irradiation. The serum Fe levels increased initially after 50 or 600 R of whole-body irradiation but then de-

creased continuously afterwards. The concentrations returned to normal, or became slightly less than normal within the 144 hr experimental period. After irradiation with a lethal dose, the Fe-binding capacities decreased by ~25%, but after sublethal amounts of irradiation they increased by 20 to 30%. The total Fe-binding capacities showed similar changes in response to the irradiation exposures used. (BBB)

24856 ORIGIN OF THE RADIORESISTANCE OF NUCLEIC ACIDS IN THE SOLID PHASE. Duchesne, Jules; Van De Vorst, Albert (Univ., Liege. Institut d'Astrophysique, Cointe-Sclessin, Belg.). Bull. Cl. Sci., Acad. Roy. Belg. (5), 51: 778-809(1965). (In French).

A detailed analysis was made of the origin of the radioresistance of desoxyribonucleic acids as determined by the free radical yields in exposure to ionizing radiation and by electron paramagnetic resonance. (D.C.W.)

24857 EFFECT OF IONIZING RADIATION ON THE PYRIMIDIC BASES OF ESCHERICHIA COLI. Prat, Roger; Nofre, Claude; Cier, Andre (Centre de Recherches du Service de Sante des Armees, Lyon). Compt. Rend., Ser. D, 262: 1292-5(Mar. 14, 1966). (In French).

Ionizing radiations attack the pyrimidic bases of bacteria with a reactivity order T > U > C in the absence of oxygen and T > C > U in the presence of air. Moreover in the presence of oxygen, the degradation velocity of the bases is higher by a factor of: 1.1 for uracil, 1.8 for thymine, and 3 for cytosine. (tr-auth)

24858 IS THE TRANSITION FROM CHROMOSOME TO CHROMATID ABERRATIONS THE RESULT OF THE FORMATION OF SINGLE-STRAINED DNA? Heddle, J. A.; Trosko, J. E. (Oak Ridge National Lab., Tenn.). Exp. Cell Res., 42: 171-7(Apr. 1966).

The effective splitting of chromosomes as measured by their response to radiations is known to occur in a period of very short duration at the end of G_1 or beginning of S. Previously it was postulated that this splitting could be a result of the separation of two halves of the DNA double helix. If this were true, a proportion of the cells in an asynchronous, rapidly growing population would be expected to contain all or most of their DNA in the single-stranded state. No such cells were detected, and so it is concluded that single-stranded DNA is not the unit of breakage of the chromosome. It follows that if DNA is found to be the unit of breakage, rather than protein or some other chromosomal element, the chromosome must be multistranded at interphase. (auth)

24859 EFFECTS OF ACRIFLAVINE AND CAFFEINE ON POST-IRRADIATION RECOVERY OF C_d AND KAPPA PHAGES IN BACTERIAL CELLS. Val'dshtein, E. A.; Kriviskii, A. S.; Paribok, V. P. (Institute of Cytology, Leningrad. Inst. of Radiational and Physico-Chemical Biology, Moscow). Genetika, No. 4, 20-3(Oct. 1965). (In Russian).

The reversibility of mutational changes induced in phage DNA was investigated. The phage was uv-irradiated in vitro, and the postirradiation recovery was performed in non-irradiated cells of the host. In the experimental series the recovery was suppressed due to the treatment with specific inhibitors of the reparation acriflavine and caffeine. Treatment of the host E. coli CK with acriflavine and caffeine did not influence either the survival or the frequency of mutations in the virulent phage C_d. In experiments with the temperate phage kappa that was reproduced on Serratia marcescens, the acriflavine and caffeine treatment considerably decreased the survival of the irradiated phage but did not affect the frequency of induced mutations. The results obtained lead to the conclusion that the uv-induced mutations in C_d kappa phages are not repaired in the host cell. (auth)

24860 COMPARATIVE STUDY OF UV-RADIATION MUTAGENIC EFFECTS ON BACILLUS SUBTILIS CELLS AND TRANSFORMING DNA. Bresler, S. E.; Kriviskii, A. S.; Perumov, D. A.; Chernik, T. P. (Inst. of High Molecular Compounds, Leningrad. Inst. of Molecular Biology, Moscow). Genetika, No. 5, 53-60(Nov. 1965). (In Russian).

Radioinduced inactivation and mutagenesis were studied in vitro in the transforming DNA of B. subtilis prototrophic strain SHGW and in vivo in intact cells of the same strain. Both processes were followed depending on the uv dose. Cell damage was considerably faster than the decrease of the transforming activity (TA) of DNA. Transforming activity was estimated by transmission of $tryp^+$ and his^+ markers to recipient strains H 25 (his^-), SB25 (ind^-, his^-) and T3 ($tryp^-$). Mutagenic effect, judged by the marker of strepthomycin resistance (Sm^r) and the fluorescent marker (F) proved to be higher (by 25 times) at the same inactivation grade as a result of irradiation of transforming DNA in comparison with mutagenic effect due to irradiation of intact cells. Irradiation of DNA both in vitro and in vivo results in formation of phenotypically identical mutants. The origin similarity and difference of processes of induced mutagenic effect both in the system of intact cells and that of transforming DNA is discussed. (auth)

24861 RADIATION-STIMULATED DNA SYNTHESIS IN CULTURED MAMMALIAN CELLS. Rasmussen, R. E.; Painter, R. B. (National Aeronautics and Space Administration, Moffett Field, Calif.). J. Cell Biol., 29: 11-19(Apr. 1966).

A type of DNA synthesis in mammalian cells that is stimulated by ultraviolet light was studied by means of radioautography and density gradient centrifugation. The characteristics of this synthesis are: it is not semiconservative; it is enhanced by the presence of 5-bromodeoxyuridine in the DNA molecule; the degree of stimulation is dose dependent; there is less variability in the rate of incorporation of H^3-thymidine during this synthesis than during normal DNA synthesis; and it occurs in cells that are not in the normal DNA synthesis phase (G_1 and G_2 cells). This kind of synthesis was found in cultured cell lines from five different species; however, in some strains, the presence of bromouracil in the DNA is required before it can be demonstrated by radioautography. (auth)

24862 HISTOCHEMICAL DETERMINATION OF EPINEPHRINE AND NOR-EPINEPHRINE IN IRRADIATED GUINEA-PIGS. Rava, G. Minerva Radiol., Fisioterap. Radiobiol., 11: 154-6(Mar. 1966). (In Italian).

The secretory function of the adrenal medulla of guinea pigs irradiated with a single 600 dose was investigated histochemically for epinephrine, and nor-epinephrine, and potassium iodate. An increase of both hormones was observed at 24 and 48 hours. After 15 days, the secretion of epinephrine was diminished as compared to the values at 24 and 48 hours, with a return to values close to those found initially, but with a stronger reaction than in control slides, in spite of the diminished secretory area, whereas the secretion of nor-epinephrine was further enhanced. The behavior of the epinephrine secretion was also compared to the 17-ketosteroid, and 11-oxycorticoid output, investigated previously. (auth)

24863 INHIBITION OF DNA SYNTHESIS BY ULTRAVIOLET LIGHT UNDER CONTROLLED TEMPERATURE. Cleaver, J. E. (Massachusetts General Hospital, Boston). Nature, 209: 1317-20(Mar. 26, 1966).

The effect of uv on the synthesis of DNA was investigated under conditions of temperature in tissue cultures of mouse L strain and human amnion cells using ^{3}H-thymidine as the tracer of DNA synthesis. A series of cultures were irradiated with a total flux of uv ranging from 400 to 4,000 ergs/mm^2, labeled for 10 min and fixed. Grain counts were made on autoradiographs of the cultures. The average grain count/labeled cell was used as the measure of ^{3}H-thymidine incorporated into DNA during the labeling period. No difference was noted between the fraction of cells that were labeled in irradiated and control regions of either cell type. It is concluded that the repair mechanism for uv injury is absent from both these cell types. Results are compared with published data on the effects of uv and x radiation on DNA synthesis in cells. (C.H.)

24864 RADIATION DOSE FRACTIONATION AND DNA REPLICATION. Looney, W. B. (Univ. of Virginia, Charlottesville). Nature, 210: 111-12(Apr. 2, 1966). (TID-21776).

The effects of dose rate on radioinduced depression of DNA synthesis were studied in a synchronous population of hepatocytes near the mid-point of the 8 hr replication period following partial hepatectomy. Two series of experiments were carried out on the effects of radiation on DNA synthesis after fractionated doses. The first series evaluated the effects of the fractionated dose (375 R × 2) on liver cells, and the second series evaluated the effects of the fractionated dose (750 R × 2) on cells of both the liver and intestine in the same animals. The major depressions of synthesis occured within the first 4 min in the 750 R × 2 group and during the first 2 min in the 375 R by 2 group. The rate of synthesis was reduced during the first few minutes to approximately ½ in the liver series and ⅓ in the intestine. (H.G.D.)

24865 INTESTINAL ABSORPTION OF GLUCOSE IN PATIENTS IRRADIATED ON THE ABDOMEN. Giannardi, G. F. (Univ., Florence); De Marzi, S.; Renzi, R.; Ciampi, G. P. Nunt. Radiol., 31: 803-27(Aug. 1965). (In Italian).

The glycemic curves resulting from oral glucose administration were studied on 42 patients irradiated abdominally. The results obtained were compared with the glycemic values observed after venous load and with the respective phosphoremic levels. The mechanism of impairment of intestinal absorption by radiotherapy was postulated. (TCO)

24866 INTESTINAL ABSORPTION OF SACCHAROSE IN PATIENTS IRRADIATED ON THE ABDOMEN. Giannardi, G. F. (Univ., Florence); De Marzi, S.; Renzi, R.; Ciampi, G. P. Nunt. Radiol., 31: 927-36(Sept. 1965). (In Italian).

The behavior of the glycemic curves after oral saccharose overloading was studied in 22 patients irradiated on the pelvis. A significant decrease of the curves after the radiation treatment was found. The absence of any simultaneous change of the phosphoremic curves and of the glycemic curves after intravenous overloading suggests the existence of a damaged intestinal absorption. On the basis of the comparison of the results obtained with previous investigation, the hypothesis is advanced that the enzymes destined for the scission of the disaccharide may also be damaged. (auth)

24867 MOUSE THYMOCYTE BETA-GLUCURONIDASE ACTIVITY AFTER WHOLE-BODY X IRRADIATION. Greenberg, Leonard J.; Cole, Leonard J. (Naval Radiological Defense Lab., San Francisco). Proc. Soc. Exp. Biol. Med., 121: 1120-2(Apr. 1966).

Beta-glucuronidase activity of mouse thymocytes was studied at various time intervals after a single whole-body sublethal dose of x rays (600 rad). Activity per cell showed an initial peak at day 2, a maximum by day 7, and returned to normal levels by day 11. Concomitant cell volume distribution analyses were carried out. The data were interpreted to indicate a positive correlation of changes in β-glucuronidase activity with changes in the medium and large thymocyte populations. (auth)

24868 THOROTRAST INHIBITION OF AMYLASE SYNTHESIS BY THE ISOLATED, PERFUSED RAT LIVER. Hiatt, N.; Coverdale, G. M.; Bonorris, G. (Cedars-Sinai Medical Center, Los Angeles). Proc. Soc. Exp. Biol. Med., 121: 1122-4(Apr. 1966).

Plasma amylase activity and plasma volume were determined in normal rats and in animals in which the reticuloendothelial system was blocked by Thorotrast. Isolated, perfused livers from normal rats synthesized amylase and released it into the perfusion medium, but livers from rats with the Thorotrast blockade of the RES neither synthesized amylase nor released it into the perfusion medium. (H.G.D.)

24869 EFFECT OF LOCAL IRRADIATION ON PROTEOLYTIC ACTIVITY OF LEUKOCYTES IN CANCER PATIENTS. Kopitar, M.; Skrk, J.; Savnik, L.; Lebez, D.; Poniz, T. (Nuclear Inst. Jozef Stefan, Ljubljana, Yugoslavia. Oncological Inst., Medical Faculty, Ljubljana, Yugoslavia). Strahlentherapie, 129: 596-603(Apr. 1966).

The changes in the catheptic activity of leukocytes before and after the application of radiotherapy are described. A dose of 100 R singly or in two fractions gives rise to a considerable increase in the catheptic activity of leukocytes. The differential blood picture and the leukocyte count do not change essentially as compared with the blood picture of healthy controls. (auth)

24870 ON THE RADIATION INACTIVATION OF RIBONUCLEASE. I. SEPARATION OF IRRADIATION PRODUCTS. Jung, Horst; Schuessler, Helga (Kernforschungszentrum, Karlsruhe, Ger.). Z. Naturforsch., 21b: 224-31 (Mar. 1966). (In German).

Ribonuclease A was irradiated in water with ^{60}Co gamma radiation, and the products formed were separated according to their molecular weight by column chromatography on Sephadex G-50. When the irradiations are carried out in nitrogen atmosphere aggregation to dimers and higher polymers is observed. An appreciable fraction of this aggregated component retains enzymatic activity. At higher doses the enzymatic activity of the aggregates is inactivated at the same rate as monomer ribonuclease A. Irradiation in air yields two components; one is equivalent to that found in nitrogen atmosphere, the other has an apparent molecular weight of about 20,000 but contains no enzymatic activity. The last component is not observed when methionine is present during irradiation. In methionine-containing solutions all inactivated ribonuclease molecules exist in the form of dimers and polymers. Irradiation in the dry state leads to the same result. Consequently, every model designed to describe the radiation action on ribonuclease has to consider the fact that in solution, in the presence of a protecting agent, and in the dry state the loss of enzymatic activity is always accompanied by aggregation to products with increased molecular weight. (auth)

Radiation Effects on Tissues

24871 (AD-625949) THE EFFECT OF ^{60}Co GAMMA RADIATION ON THE CENTRAL NERVOUS SYSTEM. Semiannual Report, August 4, 1964-February 3, 1965. Tauya, Akira (Yokohama Municipal Univ. (Japan). Faculty of Medicine). Contract DA-CRD-AG-S92-544-64-G24. 10p. (ARDG(FE)J-223). CFSTI $1.00 cy, $0.50 mn.

Different sensitivities to ionizing radiation in various parts of the brain were studied electroencephalographically. Between the frontal cortex and the hippocampus, different transition of the sleepy stage was demonstrated, suggesting dissociated response in these regions, by irradiation over 1000 R. (auth)

24872 (AFRRI-SR-66-2) INCAPACITATION IN THE MONKEY (MACACA MULATTA) FOLLOWING EXPOSURE TO A PULSE OF REACTOR RADIATIONS. Seigneur, Leslie J.; Brennan, James T. (Armed Forces Radiobiology Research Inst., Bethesda, Md.). Feb. 1966. 60p.

One hundred and thirty-one monkeys (Macaca mulatta) were exposed to scheduled doses of 2,500 through 80,000 rads of pulsed reactor radiations using a TRIGA reactor. The animals were observed with respect to survival time and until permanent complete incapacitation. Additional observations of a clinical nature were made during the postirradiation course. An early transient phase of incapacitation lasting from 5 to 30 minutes was noted at dose levels from 2,500 through 30,000 rads. This was followed by a plateau of recovered ability to respond, the duration of the plateau being inversely related to dose. With scheduled doses in the range from 40,000 through 80,000 rads, the plateau phenomenon was suppressed, partial recovery did not usually occur, and the early incapacitation was rapid, progressive, and irreversible. (auth)

24873 (N-65-35317) ELECTRON MICROSCOPY OF RAT CEREBELLAR CORTEX FOLLOWING EXPOSURE

TO IONIZING RADIATION. de Estable, Rosita F.; Estable-Puig, Juan F.; Haymaker, Webb (National Aeronautics and Space Administration, Moffett Field, Calif. Ames Research Center). [1964]. 26p. (NASA-TM-X-51592). CFSTI $2.00 cy, $0.50 mn.

The ultrastructural changes found in the irradiated cerebellar cortex of the rat following fixation by osmium perfusion are described. The cerebellum was selected for study because it contains a wide variety of easily recognized cellular types and structures in a small volume of tissue. (STAR)

24874 INVESTIGATIONS INTO THE RADIATION RESISTANCE OF TRIBOLIUM CONFUSUM (DUVAL) AND TYROPHAGUS DIMIDIATUS (HERMANN). **Farkas, J. (Central Food Research Inst., Budapest). Acta. Microbiol. Acad. Sci. Hung., 12: 15-28(1964).**

The radiosensitivity of flour beetles was examined in the dose range of 3 to 50 krad. Survival times correlated with 25 and 50% mortality (LT_{25} and LT_{50}) were established as a function of radiation doses. The lethal effect of irradiation abruptly increased between doses 6 and 12 krad, while doses over 12 krad accelerated beetle mortality only to a small degree. To sterilize adults and eggs, radiation doses of 3 to 6 krad were needed. Eggs were highly sensitive to x rays, but larval resistance was not higher than that of adults. Therefore, products can be completely disinfested by lethal doses established for adults. Also examined was whether the survival of flour beetles is affected by relative humidity during breeding subsequent to radiation applied in doses of 25 krad. Differences of LT_{50} values corresponding to different levels of relative humidity were examined by variance analysis and the results thus obtained showed that the mean survival times observed under 30 and 90% relative humidity were significantly shorter than values at 70% relative humidity. Deviations in the mean survival time, however, are practically not important because differences in LT_{50} values remained always below 25%. Radiation resistance of mites (T. dimidiatus) was investigated in the dose range of 25 to 300 rad and proved to be higher than that of the beetles, but with doses of 25 to 50 krad the reproduction of mites could also be prevented. (BBB)

24875 LOCAL AND SYSTEMIC EFFECTS OF IONIZING RADIATION ON BONE GROWTH. **Phillips, Richard D.; Kimeldorf, Donald J. (Naval Radiological Defense Lab., San Francisco). Amer. J. Physiol., 210: 1096-1100(May 1966).**

Radiation-induced retardation of femur and tibia growth was determined in young male rats 60 days after total- or partial-body exposure to 450 R of x rays. Approximately 52% of the growth reduction was attributed to local irradiation of the limb, and the remaining 48% was ascribed to systemic irradiation effects. The systemic response was not dependent on the mass of tissue irradiated, nor on the induction of postirradiation inanition. The region of the animal exposed, however, did appear to be important. By exposing various regions of the body, the systemic response was subdivided into abscopal components. Irradiation of the head, abdominal, and thoracic regions yielded 42%, 40%, and 18%, respectively, of the total systemic effect. The local and abscopal responses appeared to be additive rather than synergistic, with the total radiation effect being the resultant sum of the abscopal and local components. (auth)

24876 EFFECTS OF PRENATAL GAMMA RADIATION ON THE REPRODUCTIVE PHYSIOLOGY OF THE SPANISH GOAT. **O'Brien, Coleman A.; Hupp, E. W.; Sorensen, A. M.; Brown, S. O. Amer. J. Vet. Res., 27: 711-21 (May 1966).**

Female Spanish goats were exposed to 300 R single-exposure gamma radiation on: day 30, 40, or 50 of gestation; fractional irradiation on days 30, 40, 50; or continuous irradiation from days 30 to 50. Irradiation adversely affected the reproductive performance of irradiated does as evidenced by fewer kids than among nonirradiated, control does. Offspring from irradiated does were adversely affected. There was a lowered survival rate, decreased growth rate, decreased organ weights, decreased follicle development, and decreased sperm production with a pronounced increase in morphologically abnormal sperm. (auth)

24877 CELL CYCLE KINETICS AND RADIATION-INDUCED CHROMOSOMAL ABERRATIONS STUDIED WITH ^{14}C AND ^{3}H LABELS. **Dewey, W. C.; Humphrey, R. M.; Sedita, B. A. (Univ. of Texas, Houston). Biophys. J., 6: 247-60(May 1966).**

Chinese hamster cells in vitro were double labeled with ^{14}C TdR and ^{3}HTdR. At the time of irradiation with ^{60}Co gamma rays (600 rad), the cells in the G_2 phase were labeled only with ^{14}C, whereas cells in the late and middle S phases were labeled with both ^{14}C and ^{3}H. The cells in early S phase were labeled only with ^{3}H and the G_1 cells were unlabeled. Samples were fixed at various time intervals following irradiation and the metaphases were analyzed for chromosomal damage. The phase in which the cell was located at the time of irradiation was determined by counting grains in the first and second layers of autoradiographic film. In both control and irradiated cells some G_1 cells divided prior to some of the cells which were in the S phase denoting mixing of the populations. The G_2 phase sustained three times more chromosomal damage than the S phase. Little difference in chromosomal damage was found between the G_1 and S phases or among the different parts of the S phase. Cells in G_2 sustained a mitotic delay of 4 hr, while the other phases sustained a delay of 2 to 3 hr. Chromatid and chromosome (dicentrics) exchanges were induced in G_1 cells but only chromatid exchanges were induced in S and G_2 cells; this is consistent with the hypothesis that the chromosome consists of two subunits which separate either slightly before or immediately as the cell enters the S phase. (auth)

24878 ELIMINATION OF CHROMOSOME ABERRATIONS FROM HUMAN LYMPHOCYTES. **Norman, Amos; Sasaki, M. S.; Ottoman, R. E.; Fingerhut, A. G. (Center for the Health Sciences, Los Angeles). Blood, 27: 706-14(May 1966).**

The frequency of chromosome aberrations was measured in the lymphocytes of 36 hematologically normal women who had received radiation therapy for cervical carcinoma. The decrease with time in the frequency of cells with acentric fragments or a single dicentric, and of quasidiploid cells can be represented by a single exponential with an average lifetime, respectively, of 530 ± 64 days, 788 ± 98 days, and $5.55 \pm 1.23 \times 10^3$ days. Aneuploid cells fall into two classes: one contains no chromosomes with structural aberrations and shows a stable frequency of about 5.8 percent; the other contains chromosomes with structural aberrations and is eliminated at the same rate as cells with acentric chromosome fragments. The distribution of dicentrics among the lymphocytes at the end of the radiation therapy period is similar to that shown by a population of lymphocytes exposed in vitro to a single dose of about 300 rads. (auth)

24879 CHROMOSOME STUDIES ON WOMEN FORMERLY EMPLOYED AS LUMINOUS-DIAL PAINTERS. **Boyd, J. T. (Univ. Coll. Hospital Medical School, London); Court Brown, W. M.; Vennart, J.; Woodcock, Gillian E. Brit. Med. J., 1: 377-82(Feb. 12, 1966).**

Observations were made on 62 women who were formerly employed as luminous-dial painters. Estimated burdens ranged from a nonmeasurable body radium content to a content as high as 0.56 μC. Chromosome analyses were considered in three groups according to the body activity of radium. Control observations for chromosome studies were obtained from a randomly selected group of 57 women. Cells having dicentric or tricentric chromosomes, ring chromosomes, or acentric fragments were classified as cells with unstable abnormalities and designated as Cu cells. Cells carrying abnormal monocentric chromosomes due to such events as the reciprocal interchange of material between chromosomes or the production of pericentric inversions were said to carry stable abnormalities and were designed as Cs cells. The proportion of abnormal cells in the luminizer cases (4.5%) was higher than that in the con-

trol data (2.8%), a difference that remained evident when proportions of C_u and C_s cells were considered separately. However, the group difference in C_u cells failed to reach a significant level. The excess of structural abnormalities was not pronounced among luminizers with body burdens of 0.1 μC and over. The proportions of C_u cells (3.2%) and C cells (3.6%) among cultures from persons in this group were both significantly higher than comparable proportions in the control series (1.6 and 1.2% respectively). Among luminizers with less than 0.1 μC of radium the excess of abnormal cells was less striking, and within this range none of the individual proportions of C_u and C_s cells was significantly higher than the comparable control figure. Data as a whole, however, displayed a consistent trend of increasing structural abnormality with increase in activity of radium in the body. (TCO)

24880 THE DEVELOPMENT OF EXTERNAL GENITAL ORGANS OF THE EMBRYO OF THE BLIND WORM (ANGUIS FRAGILIS L.) IN THE ABSENCE OF GENITAL GLANDS. Raynaud, Albert; Frilley, Marcel (Institut Pasteur, Sannois, France). Compt. Rend., 261: 5641-4 (Dec. 20, 1965). (In French).

Two methods were used in the attempt to obtain the development of phallic rudiments in the absence of embryonic genital glands in order to test whether the morphogenesis of the phallus can be affected in the two sexes autonomously, independently of the embryonic genital gland secretions. The first study investigated in vitro development of the phallic rudiments in explants of the posterior part of the embryonic trunk cultivated on an hormonal synthetic medium. It was established that the differentiation of the phallic rudiments progresses in vitro in the absence of the genital glands. In the second series of experiments the embryonic genital glands were destroyed by localized x-irradiation. The microscopic study showed that the irradiation provoked a subtotal destruction of the genital glands. Although the destruction was not total, it is probable that the gonads have no endocrine activity. Nevertheless, the external genital organ of the irradiated embryos developed normally. These results indicate that the rudiments of the external genital organs of the blind worm embryos should be capable of developing and differentiating in a normal manner in the absence of genital glands. (J.S.R.)

24881 EFFECT OF SPLENECTOMY ON THE DESTRUCTION AND RESTORATION OF MEDULLARY LINES AFTER LOCALIZED IRRADIATION IN THE RAT. Michaud, C.; Manuel, S.; Chateau, D. (Faculte de Medecine, Strasbourg). Compt. Rend. Soc. Biol., 159: 2040-6(1965). (In French).

The effect of a splenectomy on the destruction and restoration of medullary tissue after x irradiation at 100 and 500 R on a segment of the limb of the rat was investigated. The results showed that a dose of 100 R affected the myeloid cells equally in the animals with a splenectomy and without. At doses at 500 R the destructive processes to the myeloid cells were maximum by the third day and the restoration was almost complete on the 21st day, a much faster destruction and restoration time than in the non-splenectomized animals. For a dose of 100 R and 500 R the destruction and restoration is almost identical for the monoblastic cells in animals with and without a splenectomy. In the splenectomized animals no significant modification was noted in the lymphocytes regardless of the radiation dose, but in the whole animals there was a sharp increase in the number of lymphocytes. (J.S.R.)

24882 EFFECTS OF A MIXTURE OF A 2-β-AMINOETHYLISOTHIOUREA, GLUTATHIONE, AND SEROTONIN ON THE RATE OF MUTATIONS INDUCED IN THE MOUSE BY X RAYS. Leonard, A.; Massin, J. R.; Deknudt, G.; Mattelin, G. (Centre d'Etude de l'Energie Nucleaire, Mol, Belg.). Compt. Rend. Soc. Biol., 159: 2075-8(1965). (In French).

Studies were made in mice on the effect of AET on the induction of dominant lethal mutations by x irradiation of the male reproductive cells. The effects of the simultaneous administration of serotonin and glutathione on the mutation rate were also studied. The results showed that this combination had an unfavorable effect since it decreased the number of living embryos resulting when the treated males were mated with normal females. (J.S.R.)

24883 REGENERATION OF ISCHEMIC TISSUE PREVIOUSLY IRRADIATED. Reznik, M.; Betz, E. H. (Univ., Liege). Compt. Rend. Soc. Biol., 159: 2078-80 (1965). (In French).

The local x irradiation of a striated muscle of rabbits prevented the regeneration that normally follows ischemic of this muscle. Mechanisms influencing this lack of regeneration are discussed. (J.S.R.)

24884 EFFECT OF X RAYS ON THE SEROTONIN CONCENTRATION OF THE BLOOD IN MICE. Momma, H.; Nakamura, W.; Eto, H. (National Inst. for Radiological Sciences, Chiba, Japan). Compt. Rend. Soc. Biol., 159: 2094-7(1965). (In French).

Whole-body x irradiation of the mouse at a relatively low dose increases initially and then reduces the serotonin concentration of the blood. The greatest reduction is found on the 10th day after irradiation. Higher doses of x rays do not increase the concentration but reduce it more intensely. (tr-auth)

24885 EFFECT OF THE SUPERNATANT OF THE CULTURE OF BORDETELLA PERTUSSIS AND OF X RAYS ON PULMONARY HISTAMINASE. Niwa, M.; Nakamura, M.; Kuwajima, Y. (Osaka Univ.). Compt. Rend. Soc. Biol., 159: 2098-2100(1965). (In French).

The injection of the rat with the supernatant of the Bordetella pertussis culture or the x irradiation of the suprarenals decreased the activity of the pulmonary histaminase and caused hypothermia. Degenerative lesions were observed in the suprarenals. (tr-auth)

24886 EFFECTS OF RADIATION-INDUCED TRANSLOCATIONS IN DACTYLIS GLOMERATA L. Heinz, D. J.; Elliott, Fred C. (Michigan State Univ., East Lansing). Crop. Sci., 4: 181-4(Mar.-Apr. 1964).

Neutron irradiation of tetraploid orchard grass resulted in a wide range of translocations, as measured by the number of multivalent chromosome associations of more than four chromosomes at diakinesis. One-half-hr irradiation at a flux of 7.7×10^8 n/cm^2/sec was more efficient in the induction and survival translocations than one-fourth-hr or one-hr treatments at the same flux. The morphologic and fertility characteristics of the one-half-hr treatment were not affected in the N_2 as compared to the F_2 check, but the one-hr treatment produced a highly significant reduction in winter survival, spring vigor, and plant weight. Three plants heterozygous for a large number of translocations and more vigorous than any found in the control population were isolated. As a result of cytogenetic studies, the increase in vigor for certain plants observed in this study was associated with chromosomal translocations. The only rearrangements observed under the light microscope were large heterozygous translocations. However, large translocations are probably accompanied by duplications, deficiencies, and smaller translocations that failed to form chiasmata. The increased vigor may be due to the breakage of linkage groups resulting in new interchange relations. Also, position effects and mutations associated with chromatin breakage and rearrangements may give new combinations affecting the metabolic activities of the plant. (BBB)

24887 IN VITRO INDUCTION OF THE GRAFT-VERSUS-HOST REACTION. Auerbach, R.; Globerson, Amiela (Univ. of Wisconsin, Madison). Exp. Cell Res., 42: 31-41(Apr. 1966).

Using an in vitro method of analysis, the graft-versus-host reaction in x-irradiated mice was studied. The host component of the graft-versus-host reaction was analyzed by use of an intervening millipore filter barrier. Splenomegaly and associated histological changes can be induced in the absence of actual entry of adult spleen cells into the explanted test fragment. Additional experiments involving quantitative aspects of the reaction are described. (auth)

24888 UV-INDUCED CHANGES IN LYSOSOMES TAGGED WITH QUINACRINE. Bastos, A. L.; Terrinha, A. M.; Vigario, J. D.; Nunes, J. F. Moura; Petisca, J. L. Nunes (Lisbon Univ.). Exp. Cell. Res., 42: 84-8(Apr. 1966).

A description is given of the changes in intravital fluorescent morphology of sheep muscle cells with incubation time, and the effects of uv illumination on embryonic cells growing in quinacrine. These observations strongly suggest a direct relation between fluorescent granules and cytoplasmatic vacuoles. The discussion of these findings was based on the concept of lysosome as a cytoplasmatic particle entity. (auth)

24889 PHOTOTAXIS OF EUGLENA WITH β AND γ RAYS. Bowne, S. W. Jr.; Mcgough, R. R. (Edinboro State Coll., Pa.). Exp. Cell Res., 42: 193-5(Apr. 1966).

Phototaxis was observed in Euglenae in pipettes containing radioactive salt solutions. The cell concentration in the sets of pipettes where radioactivity was not uniform throughout the pipette differed both from one pipette to another and with sets of pipettes in which radioactivity distribution was uniform. Cell reaction to a fixed level of radioactivity over different periods of time showed a significant difference between cell concentrations at 30 min and at 60 min, but no significant difference between cell concentration at 60 min and 90 min. It was concluded that Euglena moves towards a source of beta and gamma rays. (H.G.D.)

24890 A COMPARATIVE STUDY OF THE EFFECTS OF IONIZING RADIATION AND CHEMICAL MUTAGENS ON THE CHROMOSOMES OF PISUM SATIVUM. Ahundzade, A. I. (Inst. of Biological Physics, Moscow). Genetika, No. 2, 119-23(Aug. 1965). (In Russian).

Exposure to gamma rays, fast neutrons, or ethyl methanesulfonate (EMS) delayed mitosis in the root and terminal bud meristem cells of Pioneer peas by 10 to 12 hrs, 5 to 6 hrs, and 15 to 18 hrs, respectively. Chromosomal aberrations were maximum: at the end of the first mitosis following fast neutron exposure; toward the end of the first mitosis after treatment with EMS; and at the beginning of mitosis in gamma-irradiated plants. Following irradiation there was a shift from the chromatid type of aberration at the beginning of the first mitosis to the chromosome type towards the end. Chromatid bridges were characteristic of plants treated with EMS. (H.G.D.)

24891 INDUCTION OF MUTATIONS IN BACTERIOPHAGE T2 BY RADIOACTIVE DECAY OF ^{14}C INCORPORATED INTO DNA. Skobkin, V. S.; Mineeva, L. A. (Kurchatov Inst. of Atomic Energy, Moscow). Genetika, No. 3, 97-104(Sept. 1965). (In Russian).

It is shown that decay of ^{14}C in bacteriophage T2 incorporated into DNA is highly efficient for induction of h-mutations. In case of vegetative phage a single decay of ^{14}C in the DNA causes an increase of h-mutant rate amounting to nearly 10%. It was calculated that one decay per 100 occurring in a given locus resulted in the induction of a mutation. It was also shown that transmutation and recoil involved in ^{14}C decay in phage DNA are the major factors responsible for the observed effect. A concentration effect revealed in the course of studying induced h-mutations in T2 bacteriophage has proved to be a concurrent phenomenon. A due account of concentration effect seems to be necessary in all cases of quantitative studies of h-mutations in T2 bacteriophage. (auth)

24892 MECHANISM OF X-RAY INDUCTION OF ANEUPLOID GAMETES. Tikhomirova, M. M. (Leningrad State Univ.). Genetika, No. 4, 63-8(Oct. 1965). (In Russian).

Studies with Drosophila showed that intensity modified the effects of x-irradiation within the same dose range. Data are given also that attribute radioinduced nondisjunction in Drosophila chromosomes to chromosome breakage and reunion. (H.G.D.)

24893 DEPENDENCE OF MUTATION FREQUENCY ON THE X-RAY DOSAGES IN THE SENSITIVITY OF PREMEIOTIC AND POSTMEIOTIC STAGES OF SPERMATOGENESIS. Vatti, K. V. (Leningrad State Univ.). Genetika, No. 4, 94-9(Oct. 1965). (In Russian).

The frequency of sex-linked recessive lethal mutations was studied in Drosophila sperm and spermatogonia exposed to 100 to 3000 R doses of x rays. The data obtained indicate a linear relationship between dosage and frequency of induced mutations in mature sperm. In spermatogonia the mutation rate shows a complicated characteristic ascribed to the heterogeneity of the spermatogonial stages. At low (0 to 300 R) and high (1200 to 3000 R) doses, a linear relationship was noticed that reflects the real frequency of the corresponding sensitive and unsensitive fractions of spermatogonia. At mild doses (300 to 1200 R) the dependence of mutation rate on dosages of x rays disappeared due to the death of sensitive cells within which a mutation was induced (germinal selection). At low doses spermatogonia (sensitive fraction) are more sensitive than mature sperms. At mild and high doses the frequency of mutation in mature cells is higher than in immature ones. (auth)

24894 RADIOSENSITIVITY OF LOACH (MISGURNUS FOSSILIS L.) EGGS. Romashov, D. D.; Belyaeva, V. H. (Inst. of Biophysics, Moscow). Genetika, No. 5, 101-9 (Nov. 1965). (In Russian).

Gradual increase of the irradiation dose to nonfertilized loach eggs results in clear-cut manifestation of the Hertwig effect, initial increase followed by successive decrease in embryo damage and appearance of androgenetic haploids. Beginning with the dose equal to 50 kR the intensity of embryo damage increases due to ovoplasm injury. The dose equal to 400 kR is lethal to loach eggs. Peculiarities of behavior of an egg nucleus irradiated with a dose equal to 100 kR were studied in the course of fertilization and first cleavege fission, leading to its inactivation and subsequent development of the embryo via androgenesis. (auth)

24895 INCREASED RADIORESISTANCE OF BUCKWHEAT HYBRIDS (FAGOPYRUM SAGITTATUM AND F. EMARGINATUM). Mansurova, V. V.; Sakharov, V. V. (Inst. of Biological Physics, Moscow). Genetika, No. 5, 110-14(Nov. 1965). (In Russian).

Radiosensitivity was studied in seeds of Fagopyrum sagittum and F. emarginatum and their hybrids. Gamma doses of 3000 and 6000 R were given to both normal diploids and experimental tetraploids. Chromosomal aberrations in irradiated seeds were scored at anaphase and telophase. Diploid hybrids were significantly more radioresistant than the parent forms at the 3000 R level, and both diploid and tetraploid hybrids were more radioresistant than the parent forms at the 6000 R dose level. (H.G.D.)

24896 CYTOGENETIC ANALYSIS OF ACTION OF PROTONS WITH ENERGY OF 120 Mev ON CHROMOSOMES OF CREPIS CAPILLARIS. Shevchenko, V. V. (Inst. of Biological Physics, Moscow). Genetika, No. 5, 115-26 (Nov. 1965). (In Russian).

Crepis capillaris sprouts were exposed to protons with an energy amounting to 120 Mev (600 rad dose) and fixed every 2 hours in the course of a day. The analysis of metaphases in the cells of the root meristem showed that the maximum of aberrations was observed during the initial hours following exposure; then a gradual reduction was marked as in the case of x irradiation. Relative biological efficiency of protons of 120 Mev, in comparison with x rays of 180 kv, is somewhat higher than I. The exposure of cells at the stage of synthesis was not infrequently associated with the occurrence of two types aberrations, namely, the chromatid and chromosome ones; this is another evidence in favour of asynchronic reduplication of chromosomes. The spacing of breakages in regard to separate chromosomes and their localization within the chromosome arm are similar in plants irradiated by protons or x rays. However, substantial differences in the action of these two types of radiation were noticed. Some interesting features of proton action (120 Mev) may be explained only if one assumes the possibility of a single target origin of two chromosome breakages, and this is characteristic for massively ionizing particles. Hence, along with similar features observed in the action of protons and x rays, one observes considerable

differences that point to the different spatial distribution of energy in the charged particles when these particular types of irradiation are used. (auth)

24897 NEW FORMS OF COTTON PLANTS OBTAINED BY USE OF IONIZING RADIATION. Gulamov, M.-K. K.; Narimov, S.; Atazhanov, M. A.; Rykhsikhodzhaev, T. Genetika, No. 5, 127-34(Nov. 1965). (In Russian).

The effect of mutagenic doses of ionizing radiation in cotton plants was determined. Activation of processes of growth and productivity increase with low irradiation doses (1000 R). New cotton plant forms differ from parental ones in shrub structure, hair cover, increase of raw cotton weight, and fiber length. On the basis of the data obtained, it was concluded that it is quite possible to use ionizing radiation (gamma rays and neutrons) in selection work. (auth)

24898 EXPERIMENTAL SOMATIC MUTATIONS IN SOME POTATO TYPES. Tarasenko, N. D. (Inst. of Cytology and Genetics, Academy of Sciences, USSR). Genetika, No. 5, 145-9(Nov. 1965). (In Russian).

Radioinduced mutations in potatoes produced by irradiation of tubers with fast neutrons, gamma, or x rays are considered. It is suggested that chromosomal rearrangement, ploidy, or changes in genome may prove to be the most effective mutagenic mechanisms. (H.G.D.)

24899 MUTAGENIC ACTION OF ULTRAVIOLET RADIATION ON THE TEMPERATE LAMBDA PHAGE. Zinov'eva, E. G.; Kriviskii, A. S. (Inst. of Biological Physics, Moscow. Inst. of Radiation and Physico-Chemical Biology, Moscow). Genetika, No. 6, 16-23(Dec. 1965). (In Russian).

Dynamics of uv-reactivation of λ phage and appearance of phage mutations in the course of this process was investigated in view of radiation dose to both the phage and the bacteria as well as age of the culture. A statistically reliable increase of λ phage mutations induced by in vitro uv irradiation was found. Uvr increased the scope of mutagenesis by one order. The possible mechanisms of the orgin of mutations due to uvr are: recombinations with the host cell; increased reactivation of phages that were genetically damaged by irradiation in vitro; appearance of mutation at the moment of repair of radioinduced damage in phage DNA. (auth)

24900 EFFECT OF 1,4-BISDIAZOACETYLBUTANE ALONE AND IN COMBINATION WITH UV IRRADIATION ON CHLORELLA. Vaulina, E. N.; Anikeeva, I. D.; Shevchenko, V. A. (Inst. of Biological Physics, Moscow). Genetika, No. 6, 56-60(Dec. 1965). (In Russian).

An investigation was carried out on two Chlorella strains differing in sensitivity to mutagenic factors. Only very massive doses of 1,4-bisdiazoacetylbutane (0.5%—72 hours and 1%—10 and more hours) reduce viability of the more resistant strain LARG-1. At doses causing almost no viability decrease the dynamics of cell development did not differ from that of the control whereas larger doses caused lagging of sporulation end. Viability decreases mainly as a result of cell poisoning, cytoplasmic deterioration. Strain LARG-1 showed no increase of mutations while in the case of strain LARG-2 increase of mutation frequency was followed by a viability decrease. Simultaneous application of 1,4-bisdiazoacetylbutane and uv-irradiation increased mutability of uv-rays by 30 to 35%. (auth)

24901 RADIOSENSITIVITY OF THE NUCLEAR APPARATUS OF BONE MARROW IN VARIOUS SPECIES OF MAMMALS IN CONNECTION WITH THEIR GENERAL RADIOSENSITIVITY. Plotnikova, E. D.; Shapiro, N. I. (Inst. of Biological Physics, Moscow). Genetika, No. 6, 67-72(Dec. 1965). (In Russian).

The radioinduced frequency of chromatid aberrations was studied in bone marrow cells of rats and guinea pigs at stage G_2 after gamma doses of 50, 100, and 200 R. Frequency of chromosome aberrations in bone marrow cells per dose unit of the said animals was of the same order as comparative survival rates in the two animals. The discrepancy stated is possibly determined by the fact that radiosensitivity of an organism depends not so much on the total number of hemopoetic cells as on a small fraction of special stem cells, providing for repopulation of bone marrow. (H.G.D.)

24902 SENSITIVITY OF MAMMALIAN CELLS TO UV IRRADIATION AND POSSIBILITY OF PHOTOREACTIVATION OF CHROMOSOME ABERRATIONS. Antoshechkin, A. G. (Kurchatov Inst. of Atomic Energy, Moscow). Genetika, No. 6, 73-9(Dec. 1965). (In Russian).

It was shown that the frequency of induction of visible chromosome aberrations in uv-irradiated cultures of Chinese hamster cells is approximately twice as high in G_1 as in G_2 and is somewhat lower than in the early S stage. Cell cycle stages between uv sensitivity and inhibition were correlated with induction of chromosome aberrations. Photoreactivation of chromosome aberrations under conditions constituting photoreactivation in other organisms was not observed. (H.G.D.)

24903 PLUTONIUM INHALATION STUDIES. VII. BRONCHIOLO-ALVEOLAR CARCINOMAS OF THE CANINE LUNG FOLLOWING PLUTONIUM PARTICLE INHALATION. Clarke, W. J.; Park, J. F.; Palotay, J. L.; Bair, W. J. (Battelle Memorial Inst., Richland, Wash.). Health Phys., 12: 609-13(May 1966). (BNWL-SA-148).

Inhalation of $^{239}PuO_2$ particles by forty beagle dogs caused spontaneous death in ten animals having lung burdens of from 0.5 to 2.0 μc. Death occurred at 29 to 56 months post-exposure. The pathologic effects observed in the lungs of these animals consisted primarily of severe fibrosis followed by alveolar cell hyperplasia, and bronchiolar and squamous types of metaplasia. Five of the animals showed bronchiolo-alveolar carcinomas, an incidence of 13 per cent as compared to a primary lung tumor incidence of 0.2 per cent in canine necropsy material. All neoplasms originated in peripheral lung areas in association with particle retention, fibrosis, and bronchiolo-alveolar metaplasia. The irradiated, proliferating cells, comprising the hyperplastic and metaplastic response to lung scarring, appeared to be the nidus of tumor formation. Metastases were seen in one dog. (auth)

24904 LABORATORY STUDIES ON THE USE OF IRRADIATED STERILE MALES TO REDUCE C. FATIGANS WIED. POPULATIONS. Ramakrishnan, S. P.; Krishnamurthy, B. S.; Ray, S. N. (Central Inst. for Communicable Diseases, Delhi). Indian J. Malariol., 16: 357-64(Dec. 1962).

Studies on γ- or x-irradiated pupae of Culex fatigans included: effects of varying doses of x and γ rays on the mortality of pupae and reproductive capacity of the males hatched from them; effects of mating normal unmated females with irradiated and normal males; effects of radiation on longevity of male mosquitoes; and effects on the viability of eggs of females mated initially with irradiated males and subsequently allowed to mate with normal males. Pupal irradiation was carried out with x rays (30,000 and 14,000 R) and ^{60}Co γ rays (11,550, 7700, 5700, and 2850 R). All x-ray and some γ-ray doses were effective in inducing sterility in C. fatigans males. High doses of irradiation had no effect on egg production of the normal females with which exposed males were mated. When sterile males were mixed with normal males in different proportions and were given the opportunity to mate with normal virgin females in the lab, it was seen that the number of nonviable egg rafts increased with the increase in the proportion of sterile males. Maximum nonviability of eggs was obtained when the proportion of sterile to normal males to females was 9 : 1 : 1. Irradiation of pupae affected longevity of the adult mosquitoes. (TCO)

24905 ROLE OF THE ORTHOPHENOL–ORTHOQUINONE SYSTEM IN THE INITIAL EFFECT OF IONIZING RADIATION ON THE ORGANISM. Kuzin, A. M.; Plyshevskaya, E. G.; Kopylov, V. A.; Ivanitskaya, E. A.; Lebedeva, N. E.; Kolomijtseva, I. K.; Tokarskaya, V. I.;

Melnikova, S. K. (Inst. of Biophysics, Moscow). Int. J. Radiat. Biol., 10: 1-15(Feb. 3, 1966).

Investigating the rate of tyrosine oxidation by enzyme in a radiation field of low intensity, it was shown that the rate of the reaction was 5 to 10 times increased at 200 to 1000 R doses. The increase was partially the result of radiochemical oxidation of tyrosine. The use of spectrophotometrical and chemical methods illustrate that isolated native cell nuclear actively absorb products of tyrosine oxidation (namely, orthoquinones) from aqueous solution. The change in fluorescence of thymus nuclei in the presence of acridine orange in the case of action of orthoquinones is analogous to that in case of ionizing radiation. Using this test we showed that orthoquinones were present in the extracts from irradiated plants and rat liver. Formation of orthoquinones and increase of such orthophenols as chlorogenic and caffeic acids was illustrated quantitively by paper and column chromatography. Orthophenols–orthoquinones formed in irradiated plant tissue (extracted 24 hours after 15 kR irradiation) are absorbed by roots of normal plants and cause the depression of DNA synthesis in those plants. It was also shown that orthophenols–orthoquinones as well as γ-irradiation caused DNA-synthesis distortion, slowing down incorporation of thymidine into newly synthetized DNA. The result was an increase of the adenine/thymine ratio. Injection of radiotoxines under study to animals causes leukopenia and weight-loss the same as in case of γ-irradiation (700 R). On the basis of the experimental results, a scheme is presented for the initial radiation-induced processes in an irradiated cell. (auth)

24906 EFFECTS OF ACUTE X IRRADIATION ON PRIMORDIAL GERM CELLS IN THE FEMALE RAT. Beaumont, Heather M. (Univ. of Birmingham, Eng.). Int. J. Radiat. Biol., 10: 17-28(Feb. 3, 1966).

Pregnant rats were subjected to 100 R acute x-irradiation at 10.5 days post coitum (p.c.). The numbers of oogonia and oocytes present in the ovaries of fetuses aged 15.5 to 18.5 days were then estimated by a volumetric method. Five days after exposure the total population of germ-cells in irradiated specimens (circa 8000) was reduced to about a third of that in the controls. By 18.5 days, however, the number had risen to 39,000, which is just more than 50 percent of the normal complement of germ-cells at that period of fetal development. It was previously shown that, in contrast to primordial germ-cells, oogonia subjected to 100 R at 15.5 days p.c. succumb to delayed effects of irradiation and thus fail to undergo regeneration. It may therefore be concluded that the radiation response of female stem cells varies according to their stage of development at the time of exposure. (auth)

24907 GROWTH AND MORPHOLOGICAL CHANGES OF THYROID INTRAOCULAR GRAFTS X IRRADIATED IN VITRO BEFORE TRANSPLANTATION. Pavlovic-Hournac, Miroslava R. (Boris Kidric Inst. of Nuclear Sciences, Belgrade); Radivojevic, Dusanka V.; Pantic, V. Int. J. Radiat. Biol., 10: 51-63(Feb. 3, 1966).

The growth, morphological structure, and ^{131}I uptake of thyroid glands irradiated in vitro with 200 to 1800 R and then transplanted into the anterior eye chamber of thyroidectomized rats were investigated. The growth of irradiated grafts, in comparison with those not irradiated, is delayed one month after transplantation if grafts are irradiated with 400 R and 600 R, and after four months if they are exposed to 200 R. Doses of 1200 R and 1800 R totally inhibit growth of the grafts. With increase of radiation dose, decrease of the height of follicular epithelium, degeneration of the nuclei and cytoplasm, disappearance of boundaries between cells, desquamation of epithelium and destruction of follicles take place to an increasing extent. The intensity of lymphocyte infiltration decreases with the increase of the irradiation dose. In grafts irradiated with doses exceeding 1000 R, the capacity for uptake of ^{131}I was decreased. (auth)

24908 CONTROL OF VARIABLES IN RADIOPATHOLOGICAL STUDIES ON MAMMALIAN NERVOUS TISSUE. Carsten, A.; Zeman, W. (Brookhaven National Lab., Upton, N. Y.). Int. J. Radiat. Biol., 10: 65-74(Feb. 3, 1966).

An experimental x-irradiation technique for small rodents is described that exposes the segments T2 to T4 of the spinal cord. By keeping the volume of the irradiated tissue small in comparison with the total body volume, the predominant effect of the irradiation is a delayed necrosis of the spinal cord. Abscopal and somatic effects are thus reduced, as shown by the normal weight-curves following the irradiation. This technique permits the obtaining of reproducible lesions after a narrowly defined latency period, thus making possible longitudinal studies on pathogenesis and evolution of delayed radionecrosis of the spinal cord. Since the gaseous environment can be manipulated, studies on the oxygen-effect were carried out and preliminary results are reported. (auth)

24909 ABSCOPAL AND DIRECT EFFECTS OF WHOLE-BODY X IRRADIATION IN WEANLING RATS: KIDNEY MITOTIC ACTIVITY AND DNA CONTENT AFTER UNINEPHRECTOMY. Wachtel, L. W.; Cole, L. J.; Rosen, V. J. Jr. (Naval Radiological Defense Lab., San Francisco). Int. J. Radiat. Biol., 10: 75-82(Feb. 3, 1966).

Rats whose kidneys were lead-shielded, and that received 500 rad x-irradiation to the remainder of the body, did not show the increase in mitotic activity normally found 2 to 3 days after unilateral nephrectomy. A drastic lowering of the mitotic level also resulted from a single day of food deprivation. Kidney mitotic activity is therefore affected through abscopal means. The level of mitotic activity was not always correlated with subsequent kidney hyperplasia. A direct effect of x-irradiation was demonstrated by lead-shielding the body and irradiating only the exteriorized kidney. Doses of 2000 rad and 4000 rad, but not 1000 rad, caused a decrease in body-growth, and a significantly reduced compensatory increase in kidney-weight and DNA-content. (auth)

24910 EFFECT OF X RAYS ON THE NUMBER AND GROWTH-RATE OF LATERAL ROOTS IN VICIA FABA. Howard, Alma (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Int. J. Radiat. Biol., 10: 83-93 (Feb. 3, 1966).

Partial exposure of primary roots of Vicia faba to 300 kv x rays caused a decrease in the number and growth-rate of secondary (lateral) roots arising in the irradiated region. There were no abscopal effects: irradiation of the primary meristem, or cutting off the tip of the primary roots, did not influence the number of laterals produced. When the number of laterals emerging was expressed as a percentage of those appearing in unirradiated roots, and the log percentage survival plotted against x-ray dose, the greatest sensitivity was shown by the distal portion of the primary root from 1 to 5 cm from the tip (D_0 = 30 rad, $N \approx 8$). Above 6 cm the tissue became progressively less sensitive to inhibition of lateral root production. It is suggested that the lateral root initials are suppressed by cell-killing x rays whose effects are magnified by tissue disorientation. (auth)

24911 INHIBITION OF ROOT GROWTH BY ELECTRON RADIATION. Gray, L. H. (Mount Vernon Hospital, Northwood, Eng.); Boag, J. W. Int. J. Radiat. Biol., 10: 95-6(Feb. 3, 1966).

The greater radiosensitivity of the proliferation function in meristematic cells, as compared with some of the functions of differentiating or fully differentiated cells, is demonstrated by a comparison of the mean growth rates, relative to controls, as a function of time in Vicia faba roots. Electron doses of 20,000 and 100,000 rad delivered to the differentiating and differentiated tissues had little, if any, effect upon growth rate, whereas 200 rad delivered to the meristem brought growth to a standstill. (H.G.D.)

24912 COMPARISON OF "SUICIDES" OF BACTERIA LABELED WITH RADIOACTIVE ^{32}P AND ^{33}P. Apelgot, Sonia; Latarjet, Raymond (Institut du Radium, Paris). Int. J. Radiat. Biol., 10: 165-75(Feb. 28, 1966). (In French).

Bacterial mortality was studied in E. coli in which the nucleic acids were labeled with ^{32}P or ^{33}P. The survival curves were similar for the two isotopes, both being sigmoid with the same extrapolation number (3.5). Results indicated that the phenomenon mainly responsible for the lethal effect could not be the recoil energy applied to the newly-formed S atom. It is suggested that the effect is caused by chemical reactions induced by the in situ appearance of the sulfur atom, which is ionized and highly excited having a valence differing from that of phosphorus. (H.G.D.)

24913 INFLUENCE OF RADIATION ON MOUSE BONE MARROW AS STUDIED BY IMMUNO-ELECTROPHORETIC TECHNIQUE. Tsuchiya, Takehiko; Tamanoi, Itsuro (National Inst. of Radiological Sciences, Chiba, Japan). Int. J. Radiat. Biol., 10: 203-6(Feb. 28, 1966).

The effects of x rays (400R) on mouse bone marrow were investigated by immuno-electrophoretic techniques. Whole-body irradiated mice were sacrificed on 1, 3, 5, 7, 10, and 20 days after irradiation and bone marrow was collected for antigen separation by immuno-electrophoresis. Non-irradiated antigen exhibited nine precipitin arcs. After irradiation, four new precipitin arcs appeared and some arcs disappeared. In general, the precipitin pattern in irradiated animals was similar to that of normal ones. It is concluded that the immuno-electrophoretic patterns of mouse bone marrow were changed by ionizing radiation and that the immuno-electrophoretic technique is a very useful tool for detecting radioinduced changes in bone marrow. It is further suggested that the alterations of precipitin arcs may lead to interesting information about the process and degree of radiation damage and recovery in bone marrow. (H.G.D.)

24914 ESTIMATION OF THE REJOINING DISTANCE FOR CHROMOSOME EXCHANGES INDUCED IN DROSOPHILA SPERM BY COMBINED DOSES OF X RAYS AND NEUTRONS. Heddle, John A.; Wolff, Sheldon (Oak Ridge National Lab., Tenn.). Int. J. Radiat. Biol., 10: 207-10 (Feb. 28, 1966). (ORNL-P-1580).

Two equations were constructed to find the value of h (the rejoining distance of chromosome breaks induced by irradiating with both 250 kvp x rays and 14 Mev neutrons) at which interaction would occur. The yield of x-radioinduced exchanges (Y_x) was given by: $Y_x = 2\pi h^3 n_x(n_{x-1})/3V$ where h is the rejoining distance n_x the number of primary breaks induced by x rays and V is the volume of the sperm nucleus. The yield of neutron-induced changes was given by: $Y_N = hn_N(n_{N-1})/d$ when n_N is the number of primary breaks induced by the neutrons and d = dose × energy deposited in the nucleus per unit dose + track average LET. The yield for number of breaks from combined x and neutron irradiation was derived by substituting $n_c(n_x + n_N - 2Y_N)$ for n_X in the first equation. (H.G.D.)

24915 X-RAY EPILATION AND INJURIES. van Caneghem, P.; Beaumariage, M. L.; Lachapelle, J. M. (Univ., Liege). J. Physiol. (Paris), 57: 576(Sept.-Oct. 1965). (In French).

Exposure of 8-day-old mice to a whole-body irradiation of 550 R with 195-kv x rays produced total epilation within 8 days. After an intravenous injection of 0.1 ml of India ink/10 g body wt, the C particles were observed outside of the vessel. After injection of distilled water into the skin the mast cells were observed to be degranulated in the region of the injection. These two results showed that substances may have been liberated in part by the extravasated blood, or by the cells that were injured. Heparinized rabbit serum can protect the skin of the mouse after a localized injection, whereas heparinized rat plasma cannot. On separation of the various components of the blood it can be shown that the protective agent is released by the platelets, and that it is thermostable, dialyzable, extractable with 95% acetone, and produces contraction of the uterine horn of the estrogen-treated rat. Its action is inhibited by methysergide, and it has a radioprotective effect on epilation if given 30 min before irradiation at a dose of 0.2 ml/5 g body wt. (BBB)

24916 DIFFERENT SKIN REACTIONS AFTER APPLICATION OF RADIOACTIVE PHOSPHORUS AND RADIUM. Monateri, P. C.; Randaccio, M. (Univ., Turin). Minerva Radiol., Fisioterap. Radiobiol., 11: 150-3(Mar. 1966). (In Italian).

The different recovery capacity of the skin after contact beta-therapy with radium and radioactive phosphorus was examined. It was found that ^{32}P causes less extensive lesions and is followed by a complete recovery of the treated skin. (auth)

24917 REAGIN-LIKE ANTIBODIES IN EXPERIMENTAL INFECTIONS OF SCHISTOSOMA MANSONI AND THE PASSIVE TRANSFER OF RESISTANCE. Ogilvie, Bridget M.; Smithers, S. R. (National Inst. for Medical Research, London). Nature, 209: 1221-3(Mar. 19, 1966).

Reagin-like antibodies were detected in rats and rhesus monkeys infected with Schistosoma mansoni by a homologous passive cutaneous anaphylaxis (PCA) reaction. Reagins to S. mansoni first appeared in the serum of rats 4 weeks after exposure to either normal or x irradiated cercariae and disappeared by 12 weeks. The earliest time at which reagins were detected in the serum of monkeys varied from 6 to 16 weeks and the serum became negative in about 4 weeks. Serum from monkeys exposed several times to x irradiated cercariae (2,000 to 3,000 R) were either negative or only weakly positive. Rats readily acquired resistance to re-infection after exposure to small numbers of either normal of x irradiated cercaria while exposure of monkeys to many thousands of x irradiated cercariae did not produce as strong a resistance as that achieved with only 200 normal cercariae. Attempts were made to correlate the presence of antibodies with acquired resistance, and to determine if any resistance could be transferred by means of serum known to contain reagins. Results showed the presence of reagin-like antibodies in the serum of both rats and monkeys infected with S. mansoni. Passive transfer of immunity was achieved in rats, but not in monkeys, by injecting small amounts of reagin-containing serum intradermally in the direct path of the cercariae. No correlation between the presence of reagins in the serum and protective power was demonstrated in monkeys. (C.H.)

24918 RADIOSENSITIVITY OF IMMUNOLOGICALLY ACTIVATED CELLS. Berenbaum, M. C. (St. Mary's Hospital Medical School, London). Nature, 209: 1313-15 (Mar. 19, 1966).

The radiosensitivity of antibody-forming cells at different stages of the immune response was studied in mice injected with sheep erythrocytes and exposed to 450 R x radiation one day before antigen administration or 1, 3, 6, or 20 days afterward. Groups of mice were killed at intervals and the numbers of hemolysin-forming cells in the spleen were counted. The results indicate that this dose of radiation caused a rapid fall in the number of antibody-forming cells whenever given. There was no evidence of an increase in radioresistance after the antigen was given. (C.H.)

24919 ON THE SHAPE OF THE DOSE-RESPONSE CURVE FOR HeLa CELLS CULTURED IN VITRO AND EXPOSED TO GAMMA-RADIATION. Bedford, Joel S.; Hall, Eric J. (Churchill Hospital, Oxford). Nature, 209: 1363-4(Mar. 19, 1966).

Problems involved in the interpretation of dose-response curves in radiobiological studies are discussed. Results are reported from a study of the ^{60}Co γ dose response curve of cultured HeLa cells that show that after an initial shoulder the survival curve does not depart from a straight line down to a surviving fraction of 10^{-4} when 5×10^4 cells/plate were exposed but a continuously bending curve was obtained when the number of cells/plate was increased to 5×10^5 or 5×10^6 cells/plate. (C.H.)

24920 EFFECTS OF TOTAL-BODY X IRRADIATION IN SINGLE AND FRACTIONATED DOSES ON DEVELOPING CEREBRAL CORTEX IN RAT FETUS. Jacobs, L. A.; Brizzee, K. R. (Univ. of Utah, Salt Lake City. Univ. of Nebraska, Lincoln). Nature, 210: 31-3(Apr. 2, 1966).

Preliminary investigations of histological effects of single and fractionated 150 R doses of whole-body x-irradiation in the developing cerebral cortex of the fetal rat are reported. Results showed that more severe effects were caused by the single exposure than by fractionated doses. However, it was not determined whether the differences between single and fractional exposures may be explained entirely on the basis of cellular recovery between fractions. (H.G.D.)

24921 GRAFT-VERSUS-HOST SPECIFICITY OF LYMPHOID CELLS TRANSFORMED FROM BONE MARROW ALLOGRAFT IN SUPRALETHALLY X-IRRADIATED DOGS. Samoylina, Nina L.; Chertkov, I. L. (Central Inst. of Haematology and Blood Transfusion, Moscow). Nature, 210: 108(Apr. 2, 1966).

The participation in transplantation immunity of lymphoid cells transformed from bone marrow allografts was tested by their ability to induce a hypersensitivity reaction of the delayed type called a transfer reaction. Leukocytes were isolated from heparinized arterial blood of dogs x-irradiated (1000 R) and transplanted with allogeneic bone marrow within 7 days of intradermal injections of their own lymphocytes. Experimental results support the hypothesis that the stem cells of bone marrow allografts in supralethally x-irradiated dogs transform into immunologically competent lymphoid cells that are directed against the transplantation antigens of the recipient. Such a transplantation leads to interruption of the normal hemopoiesis of bone marrow allograft and removes its protective effect. The aggressive trend of the transformed cells against the recipient can only aggravate the recipient's radiation disease. (H.G.D.)

24922 EFFECTS OF X IRRADIATION ON THE METABOLIC CHANGES ACCOMPANYING PHAGOCYTOSIS. Selvaraj, R. J.; Sbarra, A. J. (Tufts Univ. School of Medicine, Boston). Nature, 210: 158-61(Apr. 9, 1966).

A study was conducted to establish baseline radiation effects on leukocytic metabolism in the presence and absence of particles. Experiments were carried out on peritoneal exudates from guinea pigs. In vitro irradiation of exudate guinea pig polymophonuclear neutrophils (PMN) with x-ray doses up to 50,000 R had little or no measureable effect on the phagocytic and metabolic functions of the cells. Effects of high dose (1500 R) whole-body x-irradiation on phagocytic and related abilities of casein-induced exucate PMN to oxidize glucose-1-^{14}C and formate-^{14}C were investigated. After high doses, the PMN phagocytized poorly and exhibited a lowered phagocytic-metabolic rate. Experiments conducted with low dose of whole-body x-irradiation revealed that a decreased phagocytic ability and metabolic activity of the PMN could be domonstrated on the 9th and 3rd post-irradiation days with 50 and 100 R, respectively. The possible effects of x rays on the exuate PMN under in vivo conditions were investigated by exposing guinea pigs containing a pre-induced exudate in the peritoneal cavity to 1500 R. The phagocytic and metabolic activities of these cells were similar to those obtained from non-irradiated animals. However, the same amount of irradiation decreased the phagocytic and metabolic properties of the PMN induced 6 hrs post-irradiation. It is thus indicated that the effects of irradiation on leukocyte metabolism are indirect. (H.G.D.)

24923 UNEXPECTED DOSE-RATE EFFECT IN THE KILLING OF MICE BY RADIATION. Hornsey, Shirley; Alper, Tikvah (Hammersmith Hospital, London). Nature, 210: 212-13(Apr. 9, 1966).

The $LD_{50/4}$ for electron beams and 250 kv x rays in mice was determined at dose rates between 20 and 50,000 rads/min. Results clearly show that radiation effectiveness does not increase indefinitely. Effectiveness approaches a maximum level. It is suggested that the relationship between dose rate and effectiveness depends on the kinetics of intracellular repair mechanisms and that a particularly rapid form of repair seems to operate in the epithelial cells of the small intestine. (H.G.D.)

24924 EFFECTS OF ^{60}Co γ RADIATION ON NATURAL DIGGING AND TUNNELING BEHAVIOR OF THE ANT POGONOMYRMEX CALIFORNICUS. Krebs, A.; Benson, B. (Walter Reed Army Medical Center, Washington, D. C.). Naturwissenschaften, 53: 131(1966).

The digging and tunneling behavior of ants were studied in animals exposed to γ doses of from 3900 to 156,000 R. Immediately after irradiation the ants were transferred into special tunneling containers and observed for 12 days after exposure. The complexity of the tunnel system and the amounts of sands moved decreased with increase in the radiation dose, indicating damage to the ants working ability and skill. (J.S.R.)

24925 REGULATIVE POWER OF IRRADIATED CHICK BLASTODERM. De, N. (Asutosh Coll., Calcutta); Bose, A. Naturwissenschaften, 53: 137(1966).

Freshly laid white leghorn eggs were x-irradiated at 1500 R and kept at a storage temperature of 25°C for 1, 2, 3, 4, or 5 days prior to incubation at a constant temperature of 38°C. Eggs incubated for 48 hrs immediately after irradiation served as controls. Irradiated eggs incubated one day after irradiation contained blastoderms exibiting no regulation of the embryo. Eggs incubated 3 days after irradiation showed some blastoderm control, while the eggs incubated after 5 days of irradiation exhibited much more recovery of the radiation effects. However, normal ontogeny was not observed in any of the embryos. It is concluded that some metabolic recovery occurred in eggs kept at 25°C following irradiation due to subnormal metabolic rates. However, the recovery of normal differentiation processes was not sufficient to prevent latent injuries. (H.G.D.)

24926 MODIFICATIONS TO THE ALVUS IN PATIENTS IRRADIATED ON THE ABDOMEN. Pelu', G.; Cavina, C.; Pistocchi, F. (Univ., Florence). Nunt. Radiol., 31: 945-56(Sept. 1965). (In Italian).

Radiation injuries to abdominal viscera resulting from abdominal radiotherapy are discussed in relation to the site irradiated. (H.G.D.)

24927 EARLY MODIFICATIONS OF THE ORGANIC HOMEOSTASIS DURING RADIOTHERAPY. Falcetti, E. (Univ., Rome); Matronola, V.; Paleani-Vettori, P. G. Nunt. Radiol., 31: 957-67(Sept. 1965). (In Italian).

Changes in the homeostasis that may occur in the course of the first radiation exposure were studied in patients given telecobalt therapy. Observed were changes of: the systemic arterial pressure, the extracellular water space, or the renal circulation during diuresis. No correlation was shown between the radioinduced changes and the absorbed or integral dose to morphological regulators of the systemic arterial pressure or of the quantitative distribution of organic fluids in intro- or extracellular space. (H.G.D.)

24928 THEORY OF ULTRAVIOLET ERYTHEMA. van der Leun, J. C. (State Univ., Utrecht). Photochem. Photobiol., 4: 453-8(June 1965).

A quantitative theory was developed on the basis of the diffusion equation of Fick for uv erythema, the gross manifestation of dilation of the superficial blood vessels in the dermis after irradiation of the skin. In the current theory the vasodilations are affected by a mediator substance, formed in the epidermis and diffusing into the dermis. The idea was extended into a quantitative theory which can be more critically tested against observations. The 300-nm-erythema shows reasonable agreement with the diffusion theory, the 250 nm-erythema does not. The hypothesis is advanced that uv radiation has two distinct erythemal effects on the skin: one (200 to 400 nm) by action of the radiation on the dermis and one (300 nm) by action of the radiation on the epidermis. The hypothesis is thought to be the simplest possible one that is not in conflict with known facts. The validity of the epidermal theory may be restricted to the narrow wavelength region near 300 nm, because the observations on which the theory is based were made only with polychromatic radiations containing considerable energy in this wavelength region. The observational basis of the epidermal theory is formed mainly by the phenomenon of the diffusion flush; support

is given by wheal experiments. If the hypothesis proves true, the concept of the erythemal effective energy will need reconsideration. It assumes additivity of the effects; this may be questionable if effects of different wavelengths are considered, but in the case of distinct effects originating in different skin layers it is much less likely to be justifiable. However, the concept may be applied to the two effects separately. This leads to two erythemal energies, that of the epidermal effect and that of the dermal effect. (BBB)

24929 ROLE OF THE THYMUS IN TOLERANCE. II. TRANSFER OF SPECIFIC UNRESPONSIVENESS TO BSA WITH THYMUS GRAFTING. Smith, Stanley B.; Isakovic, Katarina; Waksman, Byron H. (Yale Univ., New Haven). Proc. Soc. Exp. Biol. Med., 121: 1005-8(Apr. 1966).

In rats thymectomized and irradiated as adults and grafted with thymus from adult donors given 150 mg of bovine serum albumin (BSA) over the 3-day period immediately preceding grafting, sensitization of the delayed type and antibody formation against BSA were both inhibited. An inhibition of lesser degree was observed in rats grafted with normal thymus and given BSA intravenously at the time of grafting or given marrow from pretreated donors. It is concluded that tolerance for certain immune responses is induced in the adult thymus, even in normal animals given large systemic doses of antigen which can penetrate this organ. (auth)

24930 EFFECT OF LARGE DOSES OF SUBCELLULAR FRACTIONS ON SKIN GRAFT SURVIVAL IN MICE. Tamimi, T.; Vosika, G. J.; Aust, J. B. (Univ. of Minnesota, Minneapolis). Proc. Soc. Exp. Biol. Med., 121: 1133-5(Apr. 1966).

The distribution of transplantation antigens as manifested by their ability to induce tolerance to skin grafts across the Y, H_3, and H_2 histocompatibility barriers in mice is described. It was found that the use of large doses of subcellular fractions can successfully induce tolerance across the weak sex-linked histocompatibility difference. The transplantation antigens are widely dispersed throughout the cell with maximal concentration in the 10,000 g and 30,000 g sediments. A low incidence of tolerance was also noted when the H_3 histocompatibility difference was crossed. This was increased either by additional pretreatment with sublethal doses of x-irradiation or continuation of the antigenic injection after grafting, both of which resulted in a much higher mortality rate. (H.G.D.)

24931 EFFECTS OF THERMAL BURN AND X IRRADIATION ON EARLY MORTALITY. Baker, D. G.; Valeriote, F. A. (Brookhaven National Lab., Upton, N. Y. Univ. of Toronto). Proc. Soc. Exp. Biol. Med., 121: 1275-9(Apr. 1966). (BNL-9038).

Administration of thermal burn at times up to 96 hours before x-irradiation in rats increases mortality in the time period characteristic of radiation injury to the gastrointestinal tract. The maximum effect was observed at 72 hours. Administration of the burn at times up to 96 hours after x-irradiation decreased mortality due to injury of the gastrointestinal tract relative to those receiving the simultaneous injuries but increased mortality in the bone marrow phase of the radiation syndrome. When the thermal burn was administered at 96 hours after x-irradiation there appeared to be an inhibition of recovery in the bone marrow as shown by the reduced cell counts in the peripheral blood. The possibility that the synergism between thermal burn and x-irradiation is due to a protraction of radiation induced inhibition of cell renewal systems is suggested. (auth)

24932 OREGON MALIGNANCY PATTERN AND RADIOISOTOPE STORAGE. Bailar III, John C.; Young, John L. Jr. (National Cancer Inst., Bethesda, Md.). Public Health Rep. (U. S.), 81: 311-17(Apr. 1966).

Because of recent concern over possible contamination of the Columbia River by radioactive products from the Hanford (Washington) Atomic Storage Preserve, an independent study was undertaken to determine cancer trends in Washington and Oregon from 1934 to 1963. Results of the study revealed that in both states mortality rates for all forms of cancer combined were consistently below the mortality rate for the U. S. white population. Both states have had a consistent excess in leukemia mortality, but the excess was present before the Hanford Preserve began operation. No important mortality trends were observed in individual counties in either state. No evidence was found that persons living downstream from the Hanford Preserve or along the Pacific coast of Oregon have had an excess risk of death from cancer in general or from leukemia in particular. (auth)

24933 MORPHOLOGICAL AND SUBMICROSCOPIC BEHAVIOR OF GUINEA PIG KIDNEYS IN DIRECTED ONE-TIME AND FRACTIONATED X IRRADIATION. Mohr, Hans-Juergen; Morgenroth, Konrad Jr.; Schnepper, Elmar (Univ., Muenster, Ger.). Strahlentherapie, 129: 571-85 (Apr. 1966). (In German).

The assumption that the radiation damage to the tubules is a secondary effect and that it is exclusively of vascular origin is considered to be obsolete. During the initial phase, the primary damage to the cytoplasm with gradually progressing destruction of the mitochondria and the endoplasmic reticulum is the most important factor in the pathogenesis of the radiation damage to the nephron. The changes in tubules and glomeruli occur independently and at different times. The course and final effect of the damage to the parenchyma that leads to the shrunken kidney are influenced later on by the changes in the glomerular tufts. The importance of the changes for a possible radiation induced carcinoma is discussed. (auth)

24934 EFFECTS OF X IRRADIATION ON THE MALE SEXUAL CELLS OF THE WHITE MOUSE. Ouang, Te-Yio; Huang, Hua-liang; Chiang, Yio-ching (Inst. of Genetics, Peking). Tung Wu Hsueh Pao, 17: 246-60(Sept. 1965). (In Chinese).

Radiation effects were studied in the male sex cells of white mice killed 1, 3, 6, 12, or 24 hrs after whole-body exposure to 400 R doses of x rays. Morphological effects were studied on cells of the seminiferous epithelium. Radiosensitivity was lower in spermatocytes than in spermatogonia. (H.G.D.)

24935 USE OF γ RAYS IN RADIATIVE SELECTION OF ACTINOMYCES AUREOFACIENS. Troitskii, N. A.; Khromenko, G. V. Vestsi Akad. Navuk BSSR, Ser. Biyal. Navuk, No. 1, 59-61(1966). (In Russian).

Cobalt-60 gamma rays were used for the radiation selection of active strains of Actinomyces aureofaciens. The irradiation of dry spores at a dose of 100 krad caused an increased mutability and made it possible to select mutants with increased activity with respect to the biosynthesis of tetracyclines. The irradiated spores also had an increased germination rate. (H.G.D.)

24936 THE EFFECT OF A SUBLETHAL X IRRADIATION DOSE ON CULTURED CHICKEN HEART MYOBLASTS. Schaefer, Dieter (Univ., Bonn). Z. Zellforsch. Mikroskop. Anat., 68: 320-47(1965). (In German).

Mitotic division of cultured chicken heart myoblasts stopped immediately after irradiation with 1200 R of x ray, returning to normal after ~20 hr. Within 3 hr after irradiation a watery liquid produced in the nucleus and cytoplasm that probably contained toxic substances was transported from the nucleus into the endoplasmic reticulum by way of the perinuclear space. The less damaged mitochondria in the chondrioma became enlarged, but the more damaged mitochondria became encapsulated with other cell components that had been destroyed, and then were eliminated from the cells. Within one hr after irradiation the Golgi apparatus became reduced in size. Soon afterward they regained normal size. After 3 hr the Golgi vesicles became filled with a material that appeared dense, and were closely interspersed within the endoplasmic reticulum. The behavior of the nucleoli indicated that protein synthesis was temporarily disturbed by irradiation, because during the first few hr after ir-

radiation they appeared to be in very close contact with the nuclear membrane. This was less frequently observed in the later hr of the experiment. This effect seemed to reach its maximum during the recovery stage, and was decreased to normal towards the end of the period of reversible damage. (BBB)

Radiation Effects Therapy and Countermeasures

Refer also to abstract 24915.

24937 THE PROTECTIVE ACTION EXERCISE BY CYSTAMINE AGAINST THE EFFECTS OF A RADIOMIMETIC SUBSTANCE, NITRATED YPERITE, APPLIED TO AN EMBRYONIC ORGAN CULTIVATED IN VITRO. Kirrmann, Jean-Michel (CNRS, Nogent-sur-Marne, France). Compt. Rend., Ser. D, 262: 1296-8(Mar. 14, 1966). (In French).

An aqueous solution (12 mM) of nitrated yperite inhibited oxygen consumption by embryonic chick intestine. Cystamine doses of 16 mM, which do not affect intestinal respiration, reduced the 34% inhibition to 12% when administered prior to nitrated yperite. Cystamine did not modify inhibition of oxygen consumption when 64 mM doses of nitrated yperite were given or when nitrated yperite was administered prior to cystamine. (H.G.D.)

24938 MECHANISM OF PROTECTION AGAINST RADIATION LESIONS OF HUMAN CHROMOSOMES IN TISSUE CULTURE. Dubinin, N. P.; Dubinina, L. G.; Tarasov, V. A. (Inst. of Biological Physics, Moscow). Genetika, No. 5, 68-81(Nov. 1965). (In Russian).

Chromosomal rearrangements were studied in γ-irradiated (25 rad) embryonic human cells. A general formula for the mean number of lesions per cell was derived. Lesion deviation from the Poisson distribution pattern was observed in chemically-untreated cells that received 50 to 100 rad doses. It was concluded that the character of lesion frequency dependence on the repair system was the main determinant in radiosensitivity specificity. (H.G.D.)

24939 RADIATION PROTECTION BY SULFUR IN CYCLOHEXANE. Read, J. F.; Charlesby, A. (Royal Military Coll. of Science, Shrivenham, Eng.). Int. J. Radiat. Biol., 10: 29-42(Feb. 3, 1966).

The quantitative degree of protection offered by elemental sulphur to cyclohexane was studied for doses of 2 to 18 Mrads. The effect of change in dose rate from 0.1 to 3 Mrads/hr was shown to be negligible. The amount of dimer and hydrogen can be reduced to non-scavengable concentrations represented by G_{dimer} (non-scavengable) = 0.18 ± 0.05 and $G_{(H_2)}$ (non-scavengable) = 2.34. In the solid the protection against dimer formation is much less and the hydrogen yield is unaffected. In solution sulphur is present as S_8, ring opening occurring by attack by cyclohexyl radicals. Among the radiolysis products mercaptan and disulfide are formed with low G values, mercaptan being destroyed by the indirect effect of the radiation. Two processes of protection appear to be involved: reaction of sulfur with cyclohexyl radicals, and scavenging of hydrogen by RS· radicals to give mercaptan, which subsequently returns hydrogen (true repair). (auth)

24940 THE PROTECTIVE EFFECT OF ADENIN ON THE DEPRESSION IN LEUCOCYTE COUNT IN PATIENTS TREATED WITH CONVENTIONAL X-RAYS. Kakei, Hirotake; Arimizu, Noboru (Chiba Univ., Japan). Jap. J. Cancer Clin., 9: 693-6(Dec. 1963). (In Japanese).

A clinical investigation was made on the effect of Leucon with Adenin and of Leopon containing Adenin and Adrenochrome on the change in the peripheral leukocyte count caused by x-irradiation. The patients, mastectomized and irradiated postoperatively for breast cancer, were chosen as the objects of investigation. The patients were divided into six groups: control, Leucon 60 mg/day by injection, Leucon 60 mg/day by oral administration, Leopon 5 ml/day by injection, Leopon 20 ml/day by injection, and Leopon 30 ml/day by injection. These medical compounds were administered daily during the period of irradiation. For the groups receiving either Leucon or Leopon, the leukocyte count decreased gradually with irradiation, and the grade of its decrease was not different from that in the control group. It was concluded, therefore, that Leucon and Leopon had no protective effect for the depression in the peripheral leukocyte count caused by the x-irradiation. (tr-auth)

24941 EFFECT OF SODIUM ALGINATE IN INHIBITING UPTAKE OF RADIOSTRONTIUM BY THE HUMAN BODY. Hesp, R.; Ramsbottom, B. (United Kingdom Atomic Energy Authority, Sellafield, Eng.). Nature, 208: 1341-2(Dec. 25, 1965).

The inhibitory effect of sodium alginate on ^{85}Sr uptake from the human gastrointestinal tract was investigated. A male subject was first given sodium alginate prior to oral administration of ^{85}Sr followed at an appropriate time interval by ^{85}Sr administration without prior sodium alginate treatment. Activity measurements were made in urine, feces, and blood samples. Preliminary results show that sodium alginate lowers the amount of ^{85}Sr transferred from the human gastrointestinal tract to blood and whole body by a factor ranging from 8 to 10.4. (H.G.D.)

24942 EFFECT OF VARIOUS CELL-DISPERSING METHODS ON ABILITY OF MOUSE FETAL LIVER TO PROTECT IRRADIATED MICE. II. FRESH FETAL LIVER. Byrne, Anne F.; Hammond, Carolyn W. (Univ. of Illinois, Chicago). Proc. Soc. Exp. Biol. Med., 121: 961-3(Mar. 1966).

Cells from mouse fetal liver were dispersed by various methods and tested for their ability to protect lethally irradiated mice. Intravenous injection of 10^5, 10^6 or 10^7 cells dispersed by means of trypsin plus methocel protected well. Cells dispersed by forcing tissue through a 27-gauge needle or by exposure to pancreatin plus methocel protected well only when 10^7 cells were injected. Cells obtained by forcing fetal liver through monel mesh did not protect as well as cells dispersed by trypsin plus methocel when either 10^6 or 10^7 cells were injected. From the results of these experiments it is concluded that dispersion of mouse fetal liver cells by means of trypsin and methocel permits more multipotential cells to remain viable and that these cells are very susceptible to manipulation. (auth)

24943 RADIATION DAMAGE TO ERYTHROCYTE MEMBRANES AND ITS MODIFICATION. Nakken, Karl Ford (Norwegian Radium Hospital, Montebello). Strahlentherapie, 129: 586-95(Apr. 1966).

The x-ray induced damage to human erythrocytes in vitro and its modification by protective and sensitizing agents were studied, using the efflux of potassium ions as indicator of radiation damage. In aerated suspensions the specific OH scavengers p-aminobenzoic acid (PABA) and N-(p-aminobenzoyl) glutamic acid (PABGA) reduced the potassium efflux by a factor of two. PABGA was unable to penetrate the erythrocyte membrane in the course of 8 hours. Addition of catalase or flushing the suspension with N_2O did not affect the rate of potassium release, whereas flushing with oxygen increased potassium efflux with a factor of 1.2 compared to that found in N_2. It is concluded that the radiation induced release of potassium ions is due to the attack on the membrane of OH-radicals, generated in the extra-cellular buffer, and to direct ionizations in the membrane. The effect of OH-radicals may be due to attack on aromatic amino acids and less reactive SH-groups in the external layer of the erythrocyte membrane. Iodoacetic acid increased potassium efflux by a factor of two in aerated suspensions. This effect was strongly reduced in anoxia. N_2O raised the radiosensitizing effect of iodoacetic acid (IAA) to the level observed in aerated suspensions. The effect of IAA was virtually abolished by PABA and PABGA. It is suggested that the radiosensitizing effect of IAA in erythrocyte suspensions is due to the interaction of OH-radicals with IAA with the formation of

HOI which subsequently may attack membrane sulfhydryl groups. (auth)

24944 INVESTIGATIONS ON THE EFFECT OF GIBBERELLINIC ACID IN THE WHOLE-BODY X IRRADIATION OF GUINEA PIGS. Schwartz, Emil; Laginova, Viera (Oncological Research Inst., Bratislava). Strahlentherapie, 129: 616-21(Apr. 1966). (In German).

An increased survival rate of guinea pigs was found after application of gibberellic acid 7 days prior to and 7 days after whole-body x-irradiation. The radioprotective effect was also demonstrated by observing changes in body weight after irradiation. (auth)

Radiation Hazards and Protection

See also HEALTH AND SAFETY

Refer also to abstract 25378.

24945 (N-65-35524) THE PROBLEM OF ESTABLISHING TOLERABLE DOSES OF IONIZING RADIATION FOR CREW MEMBERS OF SPACECRAFTS. Grigor'ev, Yu. G.; Gus'kova, A. K.; Domshlak, M. P.; Vysotskii, V. G.; Raevskaya, S. A. Translation of Problema Obosnovaniya Dopustimykh Doz Ioniziruyushchey Radiatsii Dlya Chlenov Ekipazha Kosmicheskikh Korabley. 25p. CFSTI $1.00 cy, $0.50 mn.

A classification of irradiation levels was devised that can be used to evaluate cosmic radiation danger to spaceship crews during space flights. The categories set up and discussed are the tolerable dose, the dosage of justifiable risk and the critical dose. Hospital patients who had been subjected to irradiation for treatment of cancer were studied for total body condition, and dynamics of peripheral blood changes. Varying degrees of reaction were studied, and a table giving the observational results in degrees of severity of primary reaction symptoms depending on radiation dosage is presented. The data indicate that most of the individuals tolerated 25- and 50-R radiation doses well. With increasing dosage the total number of individuals without primary reaction to irradiation was observed to decrease. With a 125-R dose, only 35.8% of the examinees were without clinical symptoms of total reaction. It was determined that the critical radiation dose during short space flights is 125-R. A tentative estimate of 100 Rem/year is made for long flights. (STAR)

24946 HUMAN BODY INFLUENCE ON NEUTRON DOSE MEASUREMENT WITH ACTIVATION DOSIMETERS. Tschirf, E. (Oesterreichische Hochschule, Vienna). Atomkernenergie, 11: 228-31(May-June 1966). (In German).

An investigation was made on the effect of human absorption, scattering, and moderation of neutrons relative to dosimetry. It is shown, that there are big differences between the dose measured in air and near an anatomical model of the human body. The advantage of measuring the the neutron dose with several dosimeters at different places on the body is discussed. (auth)

24947 ^{210}Po ACTIVITY IN THE LUNGS OF CIGARETTE SMOKERS. Rajewsky, B.; Stahlhofen, W. (Max Planck-Institut fuer Biophysik, Frankfurt am Main). Nature, 209: 1312-13(Mar. 26, 1966).

The ^{210}Po content in different parts of the lungs of human cigarette smokers and non-smokers was measured. Results of preliminary studies showed that a filter has no noticeable protective effects against ^{210}Po inhalation. Measurements were made of the ^{210}Po content of parenchymal tissue, the bifurcation, bronchial tissues, and epithelium. The lung tissue from heavy smokers contained three to four times the ^{210}Po activity found in the lungs of non-smokers. Data on the α ray dose absorbed in lungs tissue are presented. The average dose rate for the basal cell layer was calculated to be 41 mrem/yr or 1.0 rem over a 25 year period. The ^{210}Po dose rate measured was small when compared to that from the decay of naturally occurring Ra and Th. It was concluded that carcinogenesis due to the inhalation of ^{210}Po with tobacco smoke is unlikely. (C.H.)

24948 CERTAIN ASPECTS OF THE PROBLEM OF RADIATION HYGIENE IN THE MEXICAN REPUBLIC AND ITS POSSIBLE SOLUTIONS. Bravo, Eugenio Martinez; Viniegra O., Gustavo; Vazquez, Salvador Gomez (Secretaria de Salubridad y Asistencia, Mexico City). Rev. Mex. Radiol., 18: 32-7(Jan.-Feb. 1964). (In Spanish).

Hazards from medical radiography in Mexico are discussed, and a program is presented for surmounting the various problems and irregularities in use. (H.G.D.)

24949 A RADIATION MONITORING SERVICE FOR PRACTISING VETERINARY SURGEONS. Lawler, D. C. Vet. Record, 77: 1565(Dec. 18, 1965).

It is pointed out that the radiation hazards from diagnostic x-ray devices used in veterinary practice have received relatively little attention. The film badge service of the Radiological Protection Service of the Ministry of Health and the Medical Research Council is available to veterinary surgeons. Initially, tests are carried out over two-week periods and extended to one month if the results justify the relaxation, and after each period a report is sent which will indicate the dose received by each person being monitored. Where the result is high, the service will help find and remove the cause. Although many veterinary surgeons may feel that their use of radiography does not justify joining such a service, they cannot be sure of the safety of their apparatus and methods until some tests have been carried out. Furthermore, the service provides against claims for damages from an employee who might develop leukemia or a similar complaint and allege that it was due to irradiation. (TCO)

Radiotherapy and Radiodiagnosis

Refer also to abstracts 25385, 25389, and 25401.

24950 (TID-22862) THE USE OF LARGE PARTICLES OF ^{90}Y OXIDE INTRA-ARTERIALLY TO TREAT CANCER. Nolan, Thomas R.; Grady, Edgar D. (Piedmont Hospital, Atlanta, Ga.). [1964]. Contract AT(40-1)-3096. 17p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Thirty-five of 51 patients with advanced and otherwise uncontrollable cancer benefited from intravascular administration of radioactive particles of yttrium oxide. Complications occurred in 22 patients. Eleven of these died, 6 due to the effects of radiation. At the end of the study period 7 patients were alive. The method offers hope to selected patients whose uncontrolled cancer can be reached through the regional circulation. (auth)

24951 ISOTOPIC PLACENTOGRAPHY USING ^{51}Cr-TAGGED ERYTHROCYTES. Vrettos, A. S.; Megapanos, E.; Costamis, P.; Binopoulos, D. (Univ. Maternity Hospital Alexandra, Athens). Amer. J. Obstet. Gynecol., 93: 957-60(Dec. 1, 1965).

A comparison is made of the value of various radioisotope methods for placental localization with an estimation of the maternal and fetal radiation doses. Particular attention is given to the ^{51}Cr-erythrocyte technique. In twenty full-term pregnant women the placenta was correctly localized with ^{51}Cr-labeled erythrocytes in all cases, and the results were clinically confirmed. Evaluation of the radiation dose received by the mother and the fetus in various procedures is discussed. The radiation dose to the fetus during the usual x-ray obstetrical diagnosis methods is 0.4 rad. During soft-tissue placentography the radiation received by the mother is 10 to 15 rad and that of the fetus approximates 1 rad. With the use of 3 μC radioiodinated serum albumin (RISA) (effective half-life of ^{131}I ~7.6 days), the total-body radiation dose received by a woman of average size is 8.7 mrad and by the fetus 4.2 mrad. However, the gonad dose of the fetus after the administration of 1 μC RISA to the mother is 1.4 mrad as compared to 1 rad when soft tissue placentography is used. With RISA there is a free proportion of 1% ^{131}I as well as

constant liberation along with the daily degradation of RISA; therefore, the radioiodine crossing the placenta may affect the fetal thyroid. An additional advantage of the ^{51}Cr-red cells method as compared to the RISA method is that ^{51}Cr probably remains entirely in the maternal circulation for the crossing of erythrocytes through the placenta barrier is negligible. (TCO)

24952 RADIOENCEPHALOCIRCULOGRAPHY: A NEW METHOD FOR EXPLORATION OF THE CEREBRAL CIRCULATION BY THE USE OF RADIOISOTOPES. Oehninger, C.; Touya, J. J.; Traibel, J.; Muxi, F.; Lapido, G.; Ferrari, M. (Hospital Maciel, Montevideo). An. Fac. Med. Montevideo, 49: 305-8(1964). (In Spanish).

The technique and preliminary results of radioencephalocirculography, a new method for study of cerebral circulation using radioisotopes, as carried out in 18 patients are described. Preliminary tests were conducted with various labeled substances, including ^{131}I-labeled lipids and bengal rose. However, the most convenient material was found to be colloidal radiogold (^{198}Au), which has a particle size of 200 to 300 Å. A dose of 65 μC was administered intravenously (antecubital vein). It was injected with a double syringe, detection being performed with the patient supine, with simultaneous recording of cardiac activity. The following segments of the radioactivity tracing are defined: elbow-basal, precapillary, postcapillary, torcular drainage, basal-torcular, total venous, and total intracranial. A case of intracranial hypertension with lengthening of the post-capillary stage is presented. (BBB)

24953 FOUR CASES OF CANCER OF THE KIDNEY AFTER PYELOGRAPHY THORIUM DIOXIDE. Chamot, A. P. H. (Univ., Geneva). Helv. Chir. Acta, 32: 510-24(Nov. 1965). (In French).

Four cases of malignant kidney tumors that appeared 23, 25, 17, and 25 yr after ascending pyelography with Thorotrast are reported. Most of the Th was found in the tumor tissues themselves. In each of these cases, as well as in other cases listed, hematuria was a major symptom. It is recommended that if hematuria or local pain should appear in a patient who is known to have renal deposits of Th, nephrectomy should be performed. (BBB)

24954 NEW QUANTITATIVE EXTERNAL MONITORING TECHNIQUE. Akcay, M. M. (Univ. of Ankara); Johnson, D. E.; Taplin, G. V.; Liu, C. K. Contract AT (04-1)-GEN-12. Int. J. Appl. Radiat. Isotop., 17: 261-8 (May 1966).

An external monitoring technique is described for measuring the amount of radioactivity within an internal organ. The variable distance between the detector and target organ or area is calculated trigonometrically by using two matched probes adjusted to register the same maximal level of activity coming from the source. The amount of radiation absorbed by the interposed tissue is determined from the ratio of transmitted counts from a low-energy nuclide such as ^{125}I, and a high-energy nuclide such as ^{131}I. Counting efficiency, i.e., the distance-radioactivity relation, is constant for a specified detector-recording system and must be determined experimentally. The formula for calculating the μC of activity within an organ source is presented. (auth)

24955 CLINICAL CANCER OF THE PROSTATE: A STUDY OF 4,000 CASES. Flocks, Rubin H. (Univ. Hospitals, Iowa City, Iowa). J. Amer. Med. Ass., 193: 559-62(Aug. 16, 1965).

Use of surgery and radiation, mainly by interstitial implantation of radioisotopes, to treat 4009 patients with prostatic carcinoma is reported. Diagrams and illustrations show how the local lesion may be destroyed by surgery alone, by interstitial irradiation alone, or by a combination of both. (TCO)

24956 QUANTIFICATION OF THE RESPIRATORY MOTION ARTIFACT IN RADIOISOTOPE SCANNING WITH THE RECTILINEAR FOCUSED COLLIMATOR SCANNER AND THE GAMMA SCINTILLATION CAMERA. Gottschalk, Alexander; Harper, Paul V.; Jiminez, Feliciano F.; Petasnick, Jerry P. (Univ. of Chicago). J. Nucl. Med., 7: 243-51(Apr. 1966).

The distortion in liver scanning caused by respiratory motion was studied with a Siemens sine-wave phantom imaged by three different instruments: a conventional scanner, a rectilinear scanner, and a gamma camera. All studies were performed with ^{99m}Tc. Counts accumulated for all studies were normalized to those obtained from the phantom under conventional scanning conditions using the 19-hole collimator. Results indicated that: respiratory motion doubles the resolution distance for the gamma camera and conventional scanner and triples the distance for the high-resolution scanning system; the resolution of the moving phantom is best with the gamma camera and worst with a conventional scanner and 19-hole collimator; high-speed scanning does not appear to affect the resolution distance; stop motion liver scintigraphs are feasible; and respiratory motion is responsible for a significant loss of resolution in lung, liver, and spleen scans, and should not be ignored. (H.G.D.)

24957 PLACENTAL SCANNING WITH ^{131}I. Cooper, R. D. Jr.; Izenstark, J. L.; Weens, H. S. (Emory Univ., Atlanta. Grady Memorial Hospital, Atlanta). J. Nucl. Med., 7: 304-7(Apr. 1966).

A method for placental localization is presented using ^{131}I and a $\frac{3}{8}$ in. thick stainless steel open flat field collimator having an internal diameter of $3\frac{1}{4}$ in. and a length of 2 in. that was adapted to the usual 3 in. crystal detector. Count rates of 1500 to 2500 per min were obtained from 5 μC of ^{131}I. Gross visualization of the placenta may be obtained, though scan definition is not that desired. Analysis with respect to point count localization of 70 scans by the method gave a 93.2% correlation. (H.G.D.)

24958 IN VIVO RADIOAUTOGRAPHY AS AN AID IN THE DETECTION OF GASTRIC MALIGNANCY. McFee, Arthur; Ackerman, Norman; Wangensteen, Owen H. (Univ. of Minnesota, Minneapolis). Med. Biol. Illustr., 16: 26-32(Jan. 1966).

Attempts to develop a radioautographic method using ^{32}P to detect stomach cancer are described. A method of in vivo detection of gastric malignancy was developed by employing techniques used in autoradiographic studies of resected stomachs. Balloons coated with photosensitive emulsion were devised so that they could be expanded inside the stomach to bring the emulsion into close physical contact with the gastric macosa. The same doses of ^{32}P (500 μC) were employed intravenously at the same time intervals as those which had proved successful in the previous in vitro studies. The autographic method described could theoretically detect early cancer of the intestinal surface distal to the stomach if intubation of the intestines could be carried out. This is, however, now a purely theoretical consideration, and studies were limited to the stomach since this is a more readily accessible area of the gastrointestinal tract. Among ~400 patients subjected to this technique, 25 of the proved 33 gastric carcinomas were correctly diagnosed (75%) but, of these, 20 were also correctly diagnosed by routine radiological techniques. Of the eight false negatives, it was believed that in six instances insufficient contact between the balloon and lesion had occurred. Two of these were obstructing lesions where contact would be expected to be difficult. In the remaining two cases, one tumor failed to concentrate ^{32}P, an unusual finding which was subsequently verified by further in vitro studies. In 64 gastric ulcer patients, eight false positive results were noted (12.5%). These were attributed to an increased uptake of ^{32}P by chronic inflammatory tissue immediately surrounding the ulcer crater. (TCO)

24959 THE VALUE OF POSTOPERATIVE RADIOTHERAPY IN BRONCHIAL CARCINOMA. Bangma, P. J.; Tonkes, E. (Geneeskundige Universiteitskliniek, Utrecht). Ned. Tijdschr. Geneesk., 109: 653-7(Apr. 3, 1965). (In Dutch).

The value of 250-kv x-ray therapy with average doses of 4643 R to the lung was investigated, and the injuries produced by such irradiation are reported. Thus, 73

cases of bronchial carcinoma treated with curative resection were studied to determine whether the prognosis could be improved by irradiation of the hilus and mediastinum. There were 36 cases treated with postoperative x radiation; 37 were not given such treatment. No evidence was found that irradiation lengthened the patient's life. On the other hand, there were certain adverse effects, such as severe pulmonary fibrosis, that bring into question the value of postoperative irradiation. Metastases were just as frequent, or even more so, in the irradiated cases. Pulmonary fibrosis was observed in 12 of the 26 irradiated cases which survived long enough for this condition to develop. (BBB)

24960 AN EXPERIMENTAL STUDY ON THE DOSE DISTRIBUTIONS AND THE INTEGRAL DOSE RATIO IN THE HIGH ENERGY RADIATION THERAPY. Yoshimoto, Seiichi (Kyushu Univ., Fukuoka). Nippon Igaku Hoshasen Gakkai Zasshi, 25: 1077-98(Dec. 1965). (In Japanese).

The ratio of the whole-body integral dose to the tumor integral dose with isodose charts was obtained for 15 Mv x rays, ^{60}Co γ rays, ^{137}Cs γ rays, and 200 Kvp x rays by means of film dosimetry, using special phantom and various types of the mode of movement. A special rotating table was designed and tested for the uniformity of the velocity of the rotation during irradiation, and these requirements were found to be satisfactory. In 15 Mv x rays, the ratio of whole-body integral dose to tumor integral dose is almost the same, for any kind of irradiation techniques, such as stationary, rotating or any angle of oscillating irradiations. With conventional 200 Kvp x rays rotation therapy increases this ratio; this means, rotational therapy will cause more severe general side effects such as radiation sickness. Supervoltage radiation concentrates at the irradiation focus a higher dose than conventional x rays, in both crossfire and moving field radiation, but at the conventional x ray therapy the difference of the concentration degree of crossfire and moving field irradiation is larger than for supervoltage therapy. Supervoltage radiation concentrates enough by the stationary irradiation, therefore 15 Mv x rays with moving field therapy is not always excellent when compared with its multifield stationary therapy and ^{60}Co moving field therapy. (NSA of Japan)

24961 OBSERVATIONS ON THE HISTOLOGICAL MODIFICATIONS OF NEOPLASTIC TISSUES FOLLOWING THE INTERSTITIAL INFUSION OF GRANULES OF RADIOACTIVE GOLD (^{198}Au). Ficari, A.; Bertolotti, A. (Univ., Rome). Nunt. Radiol., 31: 873-86(Aug. 1965). (In Italian).

Effects of radioactive gold seeds are reviewed, and the histological modifications following interstitial implantation of radioactive seeds in cases of malignant tumors of the oral cavity and lung are reported. The early and late regressive changes of the neoplastic tissue and the process of connective reparation following the complete decay of the radiation effect are described. (tr-auth)

24962 THE PLANNING OF CLINICAL INVESTIGATIVE PROGRAMS IN RADIOTHERAPY. Kaplan, Henry S. (Stanford Univ. Palo Alto, Calif.). Progr. Radiat. Therapy, 3: 200-11(1965).

The importance and execution of clinical studies in irradiated patients in relation to radiobiologic data thereby attained are discussed. The obvious justification for this type of study lies in greater value of information gained from human subjects as opposed to that from experimental animals or microörganisms. Experimental data necessitates extrapolations that may be erroneous. (TCO)

24963 TRANSVERSE SECTION AND RECTILINEAR BRAIN SCANNING WITH ^{99m}Tc PERTECHNETATE. Kuhl, David E.; Pitts, Frederick W.; Sanders, Theodore P.; Mishkin, Mark M. (Univ. of Pennsylvania, Philadelphia). Contract AT(30-1)-3175. Radiology, 86: 822-9(May 1966). (TID-22380).

A review was made of the records of 536 patients subjected to brain scanning in the initial twelve-month [illegible] of ^{99m}Tc pertechnetate with both rectilinear and transverse section scanning. Of these patients, 223 were studied with both rectilinear and section scanning, and 313 with rectilinear scanning only. The overall accuracy for detection in the 188 patients with focal lesions was 89 percent. In the normal group, 8 percent had false-positive scan diagnoses due to misinterpretation of normal vasculature. It was apparent that the normal transverse section pattern of radioactivity had to be recognized if the abnormal pattern were to be distinguished. It is concluded that, even in its present early state of development, the transverse section scan can be regarded as a clinically valuable study method, supplemental to the ordinary rectilinear brain scan. (C.H.)

24964 TRANSNASAL-TRANSSPHENOIDAL ^{90}Y PITUITARY IMPLANTATION IN THE THERAPY OF ACROMEGALY. Kaufman, B.; Pearson, O. H.; Shealy, C. N.; Chernak, E. S.; Samaan, N.; Storaasli, J. P. (Western Reserve Univ., Cleveland). Radiology, 86: 915-20(May 1966).

Yttrium-90 was introduced into the sella turcica via a transnasal transphenoidal approach in the treatment of 9 patients with active acromegaly. Five of the patients had had previous external radiation without lasting significant improvement. No mortality or significant morbidity was encountered in this group. Some have shown striking improvement with regression of acromegalic features, disappearance or amelioration of diabetes mellitus, and in all the serum growth hormone level has decreased. In one patient remission of acromegaly was obtained with retention of normal pituitary function; in another, pituitary function is normal, but the interval since therapy is short. No implantation patterns were alike since the treatment plan and geometric arrangement of the yttrium-90 rods depended upon the size and contour of the enlarged pituitary fossa, and the screw implant technics of maintaining the multiple sources in a geometric pattern allow individualization of therapy in each case. The physical characteristics of yttrium 90 are such that pituitary implantation can be accomplished even in patients previously treated with external radiation. (auth)

24965 NEW ATTEMPT AT COORDINATING RADIUM AND TELECOBALT THERAPY OF UTERINE CARCINOMA. Bsteh, Paulus (Landesfrauenklinik und Bundeshebammenlehranstalt, Salzburg, Austria). Strahlentherapie, 129: 505-11(Apr. 1966). (In German).

Problems dealing with the complementary use of percutaneous ultrahard x rays and radium to uterine carcinoma are discussed. A method is reported that permits an exact dosage at the uterus, as well as in the small pelvis, and provides some important information for carrying out a percutaneous irradiation. (auth)

24966 CLINICAL ANALYSIS OF ACUTE INTESTINAL RADIATION REACTIONS IN X, RADIUM, AND TELECOBALT IRRADIATIONS. Neumeister, Klaus; Pfeiffer, Joachim (Karl-Marx-Univ., Leipzig). Strahlentherapie, 129: 512-19(Apr. 1966). (In German).

Frequency, clinical specialities, and treatment of radiation induced intestinal reactions are discussed as a consequence of biostatistical analysis of 500 medical histories and special questionnaires. The dependency of these intestinal disturbances on other biological factors was statistically tested. (auth)

24967 ENERGY ABSORPTION MEASUREMENTS OF ^{60}Co IN THE INNER LAYERS OF MUSCLES-BONES WITH LiF SINGLE CRYSTALS. Krueger, Elke; Matschke, Siegfried; Frank, Manfred (Institut fuer Krebsforschung, Deutsche Akademie der Wissenschaften, Berlin. Technische Univ., Dresden). Strahlentherapie, 129: 559-64(Apr. 1966). (In German).

The energy absorption of ^{60}Co γ rays in the layer between lucite and gypsum was determined with thin single crystal discs of LiF. The phantom was used as a model for bone-muscle-systems. The influence of scattering on the dose variations observed was determined. (auth)

24968 CLINICAL MEASUREMENT OF TOTAL BRAIN UPTAKE OF RADIOISOTOPES. Oldendorf, W. H. (Univ.

of California, Los Angeles). Trans. Amer. Neurol. Ass., 88: 73-7(1963).

Problems associated with the detection of γ-emitting isotopes in brain lesions are discussed. In the study described an efficient crystal arrangement was used to detect γ radiation originating in the brain. It will detect about 3% of all γ rays originating in the brain and its efficiency is quite uniform throughout the cranium, so that all regions and depths are equally represented. It counts scalp, skull, and meninges with the same efficiency as brain, and all results must consider this interference. A γ-emitting isotope is administered intravenously in a dose of 0.15 μC/kg, ~1/100th of the dose required for photoscanning. After two minutes, antecubital blood sampling is commenced and periodic cranial counts are obtained. By subtracting the blood content from the total cranial content, a curve representing the actual brain tissue content as a function of time is obtained. The technique was used in a series of normal and pathologic cases using various labeled compounds. The substances studied in normal subjects were sodium iodohippurate (Hippuran), serum albumin, and rose bengal labeled with ^{131}I. Neohydrin labeled with ^{203}Hg was studied in normal and pathologic cases. (TCO)

CHEMISTRY

General

24969 (AERE-R–5097) PROCEEDINGS OF THE SEMINAR ON THE PREPARATION AND STANDARDISATION OF ISOTOPIC TARGETS AND FOILS, HELD AT A.E.R.E., HARWELL, OCTOBER 20–21, 1965. Smith, M. L. (ed.) (Atomic Energy Research Establishment, Harwell (England)). Dec. 1965. 175p. (CONF-651055). Dep. BIS $5.40. HMSO 27s. 0d.

Separate abstracts were prepared for twenty-eight of the thirty papers presented. The remaining two papers were previously abstracted in NSA as 20: 11183 and 13216. (A.G.W.)

For abstracts of individual papers see: 24970, 24974, 24975, 25024–25030, 25339–25342, 25465, 25510–25521, and 25558.

24970 (AERE-R–5097, Paper 1) SAMPLE PREPARATION AT THE CENTRAL BUREAU OF NUCLEAR MEASUREMENTS. Debus, G. H. (European Atomic Energy Community, Geel (Belgium). Central Nuclear Measurements Bureau). 4p.

The preparation and assay of samples for nuclear measurements by the Central Bureau of Nuclear Measurements (CBNM) are summarized by tables that show techniques used and their fields of application. Techniques include ultracentrifuge, electrolysis, electrospraying, electrophoresis, vapor decomposition, settling, evaporation, alloying, melting and casting, pressing, rolling, and high-precision punching. About 5000 samples will be prepared and assayed in 1965. (A.G.W.)

24971 (BNL–954, pp 50–83) CHEMISTRY AND CHEMICAL ENGINEERING DIVISION. Dwyer, O. E.; Wiswall, R. H. (Brookhaven National Lab., Upton, N. Y.).

Fused salt thermodynamics research is reported along with studies of UI_3 thermodynamics, optical spectra of fission products, and properties of fluorocarbons. Investigations of noble gases and graphite formation are discussed, and development work on chemical systems for energy storage is reported. Developmental work on fluoride volatility processes is summarized. Research and development on waste disposal is reported. Results of heat transfer studies with liquid metals are included. (J.R.D.)

Analytical Procedures

See also Separation Processes and Procedures

24972 (AD–632283) PERMANGANATE AS A CESIUM PRECIPITANT. APPLICATION TO RADIOCHEMISTRY. Shipman, W. H.; Mueller, D. (Naval Radiological Defense Lab., San Francisco, Calif.). Feb. 19, 1966. 12p. (USNRDL-TR–996). CFSTI $1.00 cy, $0.50 mn.

Cesium permanganate, instead of cesium perchlorate or cesium chloroplatinate, is suggested as the final precipitate in the radiochemical determination of cesium in order to obviate problems associated with the presence of ammonium ions. A study was made of the important parameters involved in the precipitation of cesium permanganate and in the resulting chemical yield determination of cesium by flame emission. (auth)

24973 (AD–632528) CONCENTRATION OF STRONTIUM FROM SEAWATER BY MANGANESE DIOXIDE. DETERMINATION OF ^{90}Sr IN LARGE VOLUMES OF SEAWATER. Shipman, W. H. (Naval Radiological Defense Lab., San Francisco, Calif.). Feb. 27, 1966. 21p. (USNRDL-TR–995). CFSTI $1.00 cy, $0.50 mn.

The adsorption of Sr by hydrous manganese dioxide was used to concentrate Sr in seawater. This development makes possible the analysis of large volumes of seawater for ^{90}Sr and can be used in the evaluation of global fallout. A complete radiochemical procedure is presented. (P.C.H.)

24974 (AERE-R–5097, Paper 27) CHEMICAL METHODS OF ASSAYING TARGETS. Lauer, K. F. (European Atomic Energy Community, Geel (Belgium). Central Nuclear Measurements Bureau). 11p.

The importance of accurate assay of targets used for nuclear measurements, accuracies attainable with methods presently in use, and the need for improvement of chemical analysis are discussed. Tables list methods used for determination of boric acid, thorium, uranium, and plutonium and show for each method the mg per determination, the coefficient of variation, and the estimated accuracy. (A.G.W.) (A.G.W.)

24975 (AERE-R–5097, Paper 29) ALPHA AND FISSION COUNTING OF THIN FOILS OF FISSILE MATERIAL. White, P. H. (Atomic Weapons Research Establishment, Aldermaston (England)). 7p.

A study of assay of thin foils of fissionable material by α and fission counting was restricted to foils deposited on thick backings and to counting in 2π geometry. Corrections for nonuniformity of the foil, for backscattering of the particles in the foil and in the backing, and for absorption of fragments and α particles in the foils are discussed. Apparently foils manufactured by different methods need the same correction for foil absorption of α particles but different corrections for fission fragments. It is concluded that α counting of foils in 2π geometry is accurate only for foils less than 0.1 mg/cm^2 and then only to an accuracy of ~1%. Fission counting of foils of thickness 0.1–1.0 mg/cm^2 in 2π geometry can be performed to an accuracy of 0.2–1.0% depending upon the foil thickness. (A.G.W.)

24976 (GAT–524) THE SEPARATION AND MICROANALYSIS OF NIOBIUM, TANTALUM, TITANIUM, VANADIUM, AND ZIRCONIUM; APPLICATION TO URANIUM COMPOUNDS. Vita, O. A. (Goodyear Atomic Corp., Piketon, Ohio). Mar. 18, 1966. Contract AT(33-2)-1. 12p. (CONF-651004–15). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From 9th Conference on Analytical Chemistry in Nuclear Technology, Gatlinburg, Tenn.

A rapid solvent-extraction method for the separation of microgram quantities of niobium, tantalum, titanium, vanadium, and zirconium in uranium compounds is described. The N-benzoylphenylhydroxylamine (BPHA) complexes of these elements are extracted into chloroform, as a group from 10 N HCl solutions, which separates them from gross quantities (i.e., ~10 g) of uranium and many other elements such as aluminum, copper, iron, nickel, thorium, and the rare earths. After the separation, the purified niobium, tantalum, titanium, vanadium, and zirconium can be determined by suitable chemical or spectrographic procedures. A dependable spectrochemical determination of niobium, tantalum, titanium, and zirconium in uranium compounds is based on the separation of these elements from uranium with the BPHA-chloroform-hydrochloric acid solvent extraction system. The oxides of the separated elements are dissolved in a mixture of hydrofluoric and hydrochloric acids, palladium is added as an internal standard, and the elements in solution are spark excited with the rotating disk technique. The spectra are recorded photographically and analyzed by a densitometric procedure. The limit of detection of niobium, tantalum, titanium, and zirconium is 0.2 to 0.4 microgram/gram of uranium when a sample containing 5 grams of uranium is used. The limit of error for the determination of 2 to 10 micrograms of each element is ±25 percent at the 95 percent confidence interval. (auth)

24977 (NLCO–973) A RAPID DETERMINATION OF OXYGEN IN HIGH-PURITY MAGNESIUM CHIPS BY NEUTRON ACTIVATION ANALYSIS. Twitty, B. L.; Fritz,

K. M. (National Lead Co. of Ohio, Cincinnati). May 1966. Contract AT(30-1)-1156. 23p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

A nondestructive method was developed for determining the oxygen content of magnesium chips by 14-Mev activation using a neutron generator. In this method the high-energy gamma rays of 7-second nitrogen-16, formed by the n,p reaction of oxygen-16, are measured. An internal standard is used which eliminates the need for weighing samples or making flux corrections. Hence this technique reduces the total time required for analysis. The internal standard used is the 0.976-Mev gamma ray of sodium-25, formed by the n,p reaction of magnesium-25. Precisions were determined for samples of loose and pelletized chips in air and in nitrogen atmospheres at three different flux levels. Using loose chip samples in a nitrogen atmosphere near a flux of 1×10^8 n/cm^2/sec and an average of 3 aliquots, a precision of analysis of ±0.01% oxygen was obtained at the 95% confidence level (C.L.) in the range of 0.1 to 0.3% oxygen. Under these conditions, 35 samples can be prepared, analyzed, and reported per man-day. Using pelletized samples in a nitrogen atmosphere near a flux of 1×10^9 n/cm^2/sec, a precision of ±0.006% oxygen was obtained at the 95% C.L. using an average of 3 aliquots. (auth)

24978 (NP–16004) BIBLIOGRAPHY ON THE HIGH-TEMPERATURE CHEMISTRY AND PHYSICS OF GASES AND PLASMAS. Brewer, L. (comp.) (California Univ., Berkeley). Mar. 31, 1966. 33p.

A listing is presented of 153 articles on spectroscopy of interest in high-temperature chemistry and 152 articles dealing with reactions between gases and condensed phases. (M.O.W.)

24979 (PG-Report–692) AUTOMATIC MEASUREMENT OF FREE ACIDITY IN PROCESS SOLUTIONS BY COULOMETRIC TITRATION. Wooley, D. T.; Money, J. N.; McGowan, C. R. (Production Group, United Kingdom Atomic Energy Authority, Sellafield (England)). 1966. 18p. Dep. BIS $0.80, HMSO 4s. 0d.

A titrimeter was developed for the determination of free nitric acid in aqueous and organic plutonium purification process solutions. It was installed in the plant but was not connected in-line; samples were presented to it by hand but all other actions in the analytical sequence were carried out to an automatic program. The titrant was generated by external electrolysis and the end-point was detected by photometry. (auth)

24980 (SZS–2(1966)) ANALYSENVORSCHRIFTEN ZUR BESTIMMUNG DES ^{90}Sr- UND ^{89}Sr-GEHALTES IN FALLOUT-, WASSER-, BODEN-, PFLANZEN-, MILCH-, NAHRUNGSMITTEL-, KNOCHEN- UND URINPROBEN. (Analysis Procedures for Determination of ^{90}Sr and ^{89}Sr Values in Fallout, Water, Soil, Plants, Milk, Food, Bone, and Urine Samples). Blume, W. (Staatliche Zentrale fuer Strahlenschutz, Berlin (East Germany)). Feb. 1966. 36p. Dep. mn.

Methods are outlined for the determination of ^{89}Sr and ^{90}Sr in several materials. These include fallout, rain water, fresh water, plants, milk, bones, total diet, and urine. The separation of calcium from carrier strontium is accomplished by a newly developed method which depends on the different solubilities of $Sr(NO_3)_2$ and $Ca(NO_3)_2$ in absolute n-butanol. Procedures are presented in detail. (auth)

24981 A STUDY OF SEVERAL EUROPIUM AND HOLMIUM COMPOUNDS. Spacu, P. Acad. Repub. Pop. Rom., Stud. Cercet. Chim., 13: 413-17(1964). (In German).

The synthesis of certain europium and holmium compounds with mono- and dibasic organic acids and the use of the chloro- and bromo-mandelates, respectively, in the separation and quantitative determination of europium and holmium are discussed. (Rum. Sci. Abstr.)

24982 A SIMPLIFIED TECHNIQUE FOR THE LIQUID SCINTILLATION MEASUREMENT OF RADIOACTIVITY ON PAPER CHROMATOGRAMS CONTAINING TOLUENE-INSOLUBLE ^{14}C- AND ^{3}H-LABELED COMPOUNDS. Cayen, M. N.; Anastassiadis, P. A. (McGill Univ., Montreal). Anal. Biochem., 15: 84-92(Apr. 1966).

A convenient and relatively efficient technique was developed for routine measurement of radioactivity distribution on one-dimensional paper chromatograms containing low amounts of ^{3}H- and ^{14}C-labeled compounds, which are insoluble in the scintillation solvent toluene. A pilot strip, 2 cm wide, was cut out from the chromatogram and divided into 3/4 cm bands along the length of the chromatostrip. Each band was placed in a standard 20-ml screw-top glass vial. Methanol (0.2 ml) was added and the contents shaken occasionally for 2 or 3 min. Both the methanol and filter paper band were flooded with 10 ml of scintillation fluid and the contents were counted. This technique was found to be more satisfactory in terms of efficiency and reproducibility than several other methods tested. (auth)

24983 DETERMINATION OF MANGANESE IN BONE BY NEUTRON ACTIVATION ANALYSIS. Rojas, Miguel A.; Dyer, Irwin A.; Cassatt, Wayne A. (Washington State Univ., Pullman). Anal. Chem., 38: 788-9(May 1966).

The method for determining manganese in bone by neutron activation analysis is described. The samples are dry ashed and then irradiated for 20 min in a thermal neutron flux of 3×10^{11}n/cm^2/sec. Irradiation is followed by a radiochemical purification procedure. Then the manganese is extracted into an organic phase and counted. The interference due to the fast neutron reaction ^{56}Fe(n,p)^{56}Mn was calculated using a method similar to that reported by Borg et al. A comparison of manganese determination in bone samples using colorimetric and dry-ash neutron activation methods is presented. (F.J.H.)

24984 CHEMICAL ANALYSIS OF FISSIONABLE MATERIAL. Tolk, A. Atoomenergi Haar Toepass., 8e: 23-32(Feb. 1966). (In Dutch).

The importance of chemical analysis of fissionable materials in evaluation of their quality is considered. The analysis of the principal constituents of fissionable material, determination of the impurities present, and determination of the isotopic ratio ^{235}U/^{238}U are described. (tr-auth)

24985 ANALYTICAL APPLICATIONS OF (α,n) REACTIONS. Adloff, Jean-Pierre; Schleiffer, Jean-Jacques; Urlacher, Charles (Centre de Recherches Nucleaires, Strasbourg). Bull. Soc. Chim. France, No. 2, 698-703 (Feb. 1966). (In French).

It is shown that measurements of neutron emission resulting from (α,n) nuclear reactions are suitable for the determination of some elements, particularly ^{18}O. (tr-auth)

24986 VOLTAMMETRY OF URANYL CHLORIDE IN THE EUTECTIC LITHIUM CHLORIDE–POTASSIUM CHLORIDE. Fondanaiche, Jean-Claude; Kikindai, Tivadar (CEA, Fontenay-aux-Roses, France. Ecole Centrale des Arts et Manufactures, Paris). Bull. Soc. Chim. France, No. 3, 875-82(Mar. 1966). (In French).

The quantitative analysis of a uranyl chloride solution in the eutectic LiCl–KCl at 400°C was studied by voltammetry. The indicator electrode was of graphite and its surface was relatively large. The precision was approximately 6% for concentration below 10^{-2}M. Examination of the polarization curve made it possible to propose a mechanism for the reduction for the UO_2^{2+} ion: for dilute solutions this reduction is made by the intermediary UO_2^{+} ion. Interpretation of the intensity-potential curves is made delicate, however, by the dismutation reaction of the UO_2^{+} ion and by the fact that the surface of the indicator electrode can not be renewed. (tr-auth)

24987 ACTIVATION ANALYSIS OF ARSENIC DEPOSITS OBTAINED BY OXIDATION-REDUCTION IN THE LIQUID PHASE. Flechon, Jean; Fleck, Jean-Pierre; May, Serge (Univ., Paris, Saclay, France. Centre d'Etudes Nucleaires, Saclay, France). Bull. Soc. Chim. France, No. 3, 924-6(Mar. 1966). (In French).

Arsenic deposits obtained by oxidation-reduction in the

liquid phase contain up to 2% phosphorus when the reducer used is sodium hypophosphite. A neutron activation determination was carried out, and the results were compared with those previously obtained. (tr-auth)

24988 AN ELECTROMETRIC STUDY ON THE QUANTITATIVE PRECIPITATION OF GADOLINIUM(III) AS NORMAL CHROMATE. Prasad, Sarju; Nagar, Mani Shanker (Banaras Hindu Univ., India). Chem. Anal. (Warsaw), 11: 245-8(1966).

The use of chromate ions in the conductometric microdetermination of gadolinium (III) is described. The effects of ethanol concentration, direct conductometric titrations, and reverse conductometric titrations are discussed. The titration curves are shown. A molar ratio of Gd:Cr as 2:3 was obtained from the conductometric curves and from the results given. (F.J.H.)

24989 PROPERTIES OF GAS CHROMATOGRAPHIC RADIOIONIZATION DETECTORS OF THE CROSS-SECTION TYPE WITH PARALLEL ELECTRODES. Lasa, Jan (Inst. of Nuclear Research, Krakow). Chem. Anal. (Warsaw), 11: 299-307(1966). (In Polish).

The relations between output signals and working voltage of the "cross-section" type radioionization detectors were studied for different concentrations of oxygen and nitrogen in argon. Two detectors with volumes of 600 and 40 μl were used in the experiments. The detectors contained radioactive sources in the form of tritium targets of activities of 2.6 and 0.6 C, respectively. A possible mechanism is presented of generation of the positive signals in the detectors for oxygen and nitrogen in argon, working at low voltages. (auth)

24990 DETERMINATION OF SOME TRACE ELEMENTS IN WATER BY ACTIVATION ANALYSES. Wyttenbach, A. (Eidgenoessisches Institut fuer Reaktorforschung, Wuerenlingen, Switzerland). Chimia, 20: 119-21 (Apr. 15, 1966). (In German).

The methods used in neutron activation analysis of the trace elements Ba, Ni, Cu, U, Rb, and Cs in water are described. The sample is dried, the residue irradiated together with appropriate standards, and the activities isolated using the carrier-technique. Reproducibility is between 2 and 6% (except for Ni), and sensitivity is high enough to get good results from samples of at most a few hundred milliliters. Results for several water samples are presented. (auth)

24991 SPECTROPHOTOMETRIC STUDIES OF URANIUM(VI)-3-BENZYL-4, 5-DIHYDROXYCOUMARIN COMPLEX. Jain, B. D.; Kumar, Raj (Univ. of Delhi). Curr. Sci. (India), 35: 173-5(Apr. 5, 1966).

3-Benzyl-4,5-dihydroxycoumarin was studied as a spectrophotometric reagent for uranium. The studies were carried out at 410 mμ where the molar extinction coefficient of the reagent was only 0.04×10^3 and that of the complex was 2×10^3. Optical density measurements of the complex at different pH's showed that the complex exhibited maximum adsorption at pH 3.9 to 4.1. The optical density of the complex was found to be constant for 24 hr and obeyed Lambert-Beer's law, at 410 mμ, up to 36 ppM of uranium in solution. The average value of log K was found to be 5.0 ± 0.2 at 20 to 22°C in 40% ethanolic solution. Interference due to cerium, iron, molybdenum, thorium, and titanium ions in minute amounts is discussed. The recommended procedure for estimating uranium in the presence of foreign ions is given. (F.J.H.)

24992 USE OF RADIOACTIVE SOURCES OF CHARACTERISTIC RADIATION FOR X-RAY STRUCTURAL ANALYSIS. Lobov, S. I.; Tsukerman, V. A. Dokl. Akad. Nauk SSSR, 165: 1278-9(Dec. 21, 1965). (In Russian).

A ^{54}Fe foil was irradiated by thermal neutrons to produce a source of radioactive iron. The ^{55}Fe content was approximately 0.25%. An exposure time of 5 hours produced weak interference traces from the (011) plane of the iron specimen on x-ray film. It is necessary to separate the ^{55}Fe isotope from the ^{54}Mn isotope for practical use as a radiation source. It would be desirable to increase the ^{55}Fe-concentration in the iron foil to 25–30% which would increase the radioactivity of this source by two orders of magnitude over the sources used in this work. Enriched sources may be used successfully in diffractometry when recording the interference maxima of scintillation counters. The use of sources based on radioactive iron and vanadium would cut down on shielding requirements. (ATD)

24993 DETERMINATION OF HAFNIUM IN ZIRCONS AND THEIR PRODUCTS BY THE NEUTRON-ACTIVATION METHOD WITHOUT RADIOCHEMICAL SEPARATION. Lobanov, E. M.; Khusnutdinov, R. I. (Inst. of Nuclear Physics, Academy of Sciences, Uzbek SSR). Dokl. Akad. Nauk UzSSR, No. 1, 31-4(1966). (In Russian).

Three methods for the determination of Hf in Zr minerals by means of neutron-activation analysis are described: determination of Hf by the ^{181}Hf isotope using a single-crystal gamma spectrometer, by the ^{181}Hf isotope using a gamma-gamma coincidence spectrometer, and by the ^{180m}Hf isotope using irradiation of the samples in a Cd shell and a gamma-gamma coincidence spectrometer. The accuracy of the methods is discussed, and sample spectra are shown. Results of determining Hf in monomineral zircon, zirconium concentrate, and technological tailings are presented, and advantages of the methods are compared. (M.J.T.)

24994 DETERMINATION OF LANTHANUM AND CERIUM IN MINERALS WITH THE AID OF ACTIVATION ANALYSIS. Babaev, O.; Lobanov, E. M. Dokl. Akad. Nauk Uz SSR, No. 4, 22-5(1964).

An installation with a scintillation γ spectrometer, intended for determination of La and Ce in mineral samples irradiated in a reactor is discribed. It consists of a 100-channel pulse-height analyzer, stabilized high-voltage rectifier, vertical lead housing containing a spectrometric single crystal of NaI(Tl) 40 mm in dia and 50 mm in height, and a photomultiplier with cathode follower. Energy calibration of the spectrometer was carried out with the aid of the known lines of the isotopes ^{203}Hg (279.5 kev), ^{137}Cs (661 kev), ^{56}Mn (840 kev), ^{60}Co (1.17 and 1.33 Mev), and ^{24}Na (1.38 and 2.75 Mev), and also with the aid of the γ lines of radioactive isotopes obtained on irradiation of standards. The isotopes of La and Ce were determined directly from the energies of the γ lines observed in the spectrum, and also by supplementary measurements of the half-life spectra. The samples investigated were those of monazite, orthite, davidite, euxenite, and garnet from different deposits. An analysis of the spectra showed that the content of La and Ce fluctuates over a wide range, depending on the type of the mineral and on their variety. The content of La and Ce was determined by comparing the activities of the samples with the activities of standards of La and Ce irradiated together with the samples. (ATD)

24995 OBSERVATIONS ON THE EARLY STAGES OF OXIDATION OF ZIRCONIUM AND ZIRCALOY-2. Dawson, J. K.; Baugh, Una C.; White, J. F. (Atomic Energy Research Establishment, Harwell, Eng.). Electrochem. Technol., 4: 137-42(Mar.-Apr. 1966).

Early stages of the oxidation of zirconium and Zircaloy-2 by oxygen and water vapor at 300° to 360°C were studied using vacuum microbalances. Oxidation proceeded according to a mixed parabolic rate law up to about 1 mg dm^{-2}; zirconium oxidized more slowly than Zircaloy-2. There was a transition to a lower parabolic rate for electropolished material, and to a higher rate and more complex behavior for pickled material. The results were interpreted in terms of diffusion of oxygen ions through the oxide film. Supporting information was obtained from step changes of pressure and temperature during oxidation. The presence of hydrogen species from the water vapor influenced the transport of oxygen ions through the oxide. (auth)

24996 USE OF THE EXTRACTION PHOTOMETRIC METHOD WITH ARSENAZO-III FOR DETECTING URANIUM IN THE URINE. Novikov, Yu. V.; Abramov, L. N.

(Erisman Scientific-Research Inst. of Hygiene, Moscow). Gig. Sanit., 2: 57-8(Feb. 1966). (In Russian).

In cases requiring the determination of uranium with high accuracy, such as in the urine of animals treated with uranyl nitrate through the gastrointestinal tract, a modified version of the extractive-photometric method was found to yield good results. It involves the extraction of the uranium from a dry residue of the evaporated urine by tributyl phosphate dissolved in carbon tetrachloride, followed by the addition of a 0.006% solution of Arsenazo-III at pH = 3.0. After determining the optical density of the colored solution, the uranium concentration is obtained by referring to a reference curve. In the absence of disturbing elements, the relative error of the measurement is below 3.3%. The method was used for determining the uranium concentration in the urine of three rabbits given daily 10,000 μg of uranyl nitrate (calculated as U) in 100 ml of water by means of a stomach probe. The rabbits eliminated daily an average 10.5 μg of U, amounting to 0.1% of the daily amount. These results agreed with the data reported by T. Chapman and S. Hammons. (TTT)

24997 POLAROGRAPHY OF EUROPIUM IN FORMAMIDE. Gaur, J. N.; Zutshi, K. (Univ. of Rajasthan, Jaipur, India). J. Electroanal. Chem., 11: 390-2(May 1966).

The polarography of Eu^{3+} was studied in formamide medium at the dropping mercury electrode. The europium solution was prepared by dissolving Eu_2O_3 in perchloric acid. Sodium perchlorate was used as the supporting electrolyte. Europium gave a single well-defined wave in aqueous solution and in mixtures containing 20, 40, 60, 80, and 100% formamide. The half-wave potential shifted to the negative side with increasing concentration of formamide up to 60% and then decreased in 80% formamide. The wave height decreased as the concentration of formamide up to 60% and then decreased in 80% formamide. The wave height decreased as the concentration of formamide was increased. Thus, the polarographic reduction of Eu^{3+} in formamide affords an interesting method for the determination of europium. (J.G.B.)

24998 NEUTRON ACTIVATION ANALYSIS: THE STABILITY OF MANGANESE CONCENTRATIONS IN HUMAN BLOOD AND SERUM. Cotzias, G. C.; Miller, S. T.; Edwards, Judith (Brookhaven National Lab., Upton, N. Y.). J. Lab. Clin. Med., 67: 836-49(May 1966). (BNL-9236).

By virtue of its participation in functions ranging from oxidative phosphorylation to the formation of bone, manganese seems to be essential to all living organisms. Clinical interest in this nutrient has been limited by its incredibly low concentrations in the accessible liquid compartments of man. Analysis of such low concentrations required high sensitivity with exquisite control of contamination. Both specifications appeared to be met by neutron activation analysis (NAA). Oral administration of manganous sulfate, in large amounts, for long time periods, showed no detectable effects on a large number of clinical parameters tested under metabolic ward conditions. However, there were observed moderate increments in the manganese concentration of whole blood and minor increments of the metal's concentration in serum. Still, additions of manganous sulfate to serum in vitro showed that the metal became extensively bound in a nondialyzable form. (auth)

24999 THE USE OF 2-(2'-THIAZOLE AZO)5-DIETHYLAMINOPHENOL IN THE SPECTROPHOTOMETRIC DETERMINATION OF TRACE SCANDIUM. Hung, Shui-chieh; Teng, Hsin-chien. K'o Hsueh T'ung Pao, No. 6, 543(1965).

2-(2'-Thiazole azo)-5-diethylaminophenol (TAE), which has a highly sensitive red color reaction to scandium, was prepared. At pH values >4, scandium forms a red-colored complex with TAE that is easily detected by spectrophotometry. Optimal conditions for coloration are temperatures between 15 and 60°C, and a pH of 5.6 to 6.5. The molar extinction coefficient was determined as 1.3×10^5. The response sensitivity when $\log I_0/I = 0.001$ was 0.00070 micrograms of scandium/cm^2. Concentrations of scandium below 0.8 microgram per ml were most suitable for its detection. The stability of the color complex and anion-cation interference was also investigated. (ATD)

25000 NEUTRON ACTIVATION ANALYSIS AND ARCHAEOLOGY. Ashworth, Michael J. (Canadian Historic Sites Div., Ottawa); Abeles, Thomas P. Nature, 210: 9-11(Apr. 2, 1966).

A review is given on the use of neutron activation analysis for analysis of archaeological materials. (L.B.S.)

25001 RADIOCHEMICAL METHOD FOR THE DETERMINATION OF CESIUM, STRONTIUM, AND RUTHENIUM IN AIRBORNE AND SURFACE FALLOUT. Chandrasekaran, V. R.; Lalit, B. Y. (Atomic Energy Establishment, Trombay, India). pp 57-62 of Proceedings of the Nuclear and Radiation Chemistry Symposium, 1964. Trombay, India, Atomic Energy Establishment, 1965.

A radiochemical procedure was developed for quick separation and determination of ruthenium, cesium, and strontium isotopes in surface fallout and air filters. To preclude the loss of these isotopes by volatilization, dry ashing was avoided and the samples were effectively leached out with a dilute acid mixture in the presence of isotopic carriers. Ruthenium was separated by homogeneous precipitation of the sulfide from the leach solution, cesium was concentrated in nearly pure form on ammonium molybdophosphate, and strontium was precipitated by fuming nitric acid. A recycle of these steps and counting in a low background beta counter with anticoincidence shield ensures decontamination factors of not less than 10^3 and an error not more than 10% at the picocurie level of each isotope. (auth)

25002 DETERMINATION OF IODIDE IN PRESENCE OF LARGE AMOUNTS OF BROMIDE AND CHLORIDE BY NEUTRON ACTIVATION ANALYSIS. Pendharkar, M. S.; Reddy, G. Rami (Atomic Energy Establishment, Trombay, India). pp 63-5 of Proceedings of the Nuclear and Radiation Chemistry Symposium, 1964. Trombay, India, Atomic Energy Establishment, 1965.

A method was developed to separate ^{128}I activity from large excesses of bromine and chlorine activities. It is based on the selective homogeneous precipitation of silver iodide from highly ammoniacal solutions by controlled expulsion of ammonia. By operating at about 80% chemical yield for iodide, it was possible to achieve a decontamination factor of about 10^4 from both bromide and chloride activities. (auth)

25003 DETERMINATION OF STABLE STRONTIUM IN MILK BY NEUTRON ACTIVATION ANALYSIS. Hingorani, S. B.; Chandrasekaran, V. R. (Atomic Energy Establishment, Trombay, India). pp 66-8 of Proceedings of the Nuclear and Radiation Chemistry Symposium, 1964. Trombay, India, Atomic Energy Establishment, 1965.

The concentration of stable strontium in samples of Indian milk was estimated by neutron activation methods. The milk ash samples were subjected to neutron irradiation in the Apsara Reactor. After irradiation and cooling, strontium with the added inactive carrier was separated from calcium and other isotopes by successive nitric acid precipitations. The samples were counted for gamma activity using a 10-channel analyzer. The gamma peaks at 0.39 Mev corresponding to ^{87m}Sr produced by the ^{86}Sr (n,γ) reaction, were identified. The purity of the chemical separation was confirmed by following the 2.8 hr decay of ^{87m}Sr. The concentration of stable strontium in Indian milk varied from 106 to 830 ppM of milk ash. The mean deviation in ppM for a quadruplicate analysis was less than 10%. (auth)

25004 SEPARATION OF RADIOZIRCONIUM FROM FALLOUT SAMPLES. Khandekar, R. N. (Atomic Energy Establishment, Trombay, India). pp 69-72 of Proceedings of the Nuclear and Radiation Chemistry Sympo-

sium, 1964. Trombay, India, Atomic Energy Establishment, 1965.

An analytical procedure is described for the separation of radiozirconium from surface fallout and air filter samples. It is separated from other fission products by solvent extraction. Zirconium in a 4M nitric acid and 3M perchloric acid mixture is extracted by shaking with equal volumes of 0.5M thenoyltrifluoroacetone (TTA) solution in xylene. Radioiodine, the only fission product extracted with zirconium, is removed during the preparation of the samples and therefore the xylene phase is directly counted without stripping. Quantitative recovery makes yield determination unnecessary. The zirconium gamma activity is measured using a well-type scintillation crystal. (auth)

25005 SPECIFIC ACTIVITY AFTER INTERMITTENT IRRADIATION. Iyer, R. Krishnamoorthy (Atomic Energy Establishment, Trombay, India). pp 105-11 of Proceedings of the Nuclear and Radiation Chemistry Symposium, 1964. Trombay, India, Atomic Energy Establishment, 1965.

A simplified approach to determining specific activity after intermittent irradiation is presented. The method consists of expressing an irradiation period as an equivalent decay period so that the cooling period can be added to this. Change of flux is treated as an additional cooling period. A standard curve is drawn on a log-log scale with irradiation half lives on the Y axis and equivalent cooling half lives on the X axis. Mathematical formulations of the principles are given. (M.C.G.)

25006 PARTICLE SIZE DISTRIBUTION BY ACTIVATION SEDIMENTATION. Gangadharan, S.; Das, M. Sankar (Atomic Energy Establishment, Trombay, India). pp 175-9 of Proceedings of the Nuclear and Radiation Chemistry Symposium, 1964. Trombay, India, Atomic Energy Establishment, 1965.

Particle size distribution analysis using neutron activation and gravity sedimentation is described. The method applied to ThO_2, consists of irradiating the sample, dispersing it in a suitable medium contained in a cylindrical column, and following the activity at a particular level with time. The activity measurements were made with a NaI (Tl) scintillation setup. The size distribution was determined using Stokes law. (auth)

25007 STABLE STRONTIUM IN SEA WATER BY ACTIVATION TECHNIQUE. Rao, S. R.; Khan, A. A.; Kamath, P. R. (Atomic Energy Establishment, Trombay, India). pp 199-204 of Proceedings of the Nuclear and Radiation Chemistry Symposium, 1964. Trombay, India, Atomic Energy Establishment, 1965.

A re-examination of the method of estimating stable strontium in sea water by activation analysis is suggested. An alternative technique to improve sensitivity of detection and eliminate radiation exposure is described. In the method of Smales, Bowen, and others 1 to 2 ml of sea water are irradiated in sealed tubes and ^{87m}Sr is counted for the 0.39-Mev gamma after radiochemical separation. A method is described where 10 ml of sea water are taken for preliminary precipitation of strontium as oxalate along with added calcium. The calcium oxalate precipitate is collected on a filter paper and transferred to a polythene folder and sealed. Samples and a standard are encapsulated in a Harwell can and irradiated overnight in Apsara. The irradiated samples are taken in solution in nitric acid along with inactive strontium carrier and counted for ^{87m}Sr activity after radiochemical separation. The modified method was checked for contamination from introduced chemicals and loss of strontium in manipulations by tracer techniques. A direct irradiation of a 10 ml sample gave about 80 mr/hr, until the ^{24}Na was eliminated from solution, while the technique described eliminates chances of any detectable exposure to personnel. The method gives improved counting statistics since larger amounts of strontium are available and is useful in routine measurements of sea water samples obtained even under monsoon conditions. (auth)

25008 RAPID ANALYSIS OF RARE EARTH ALLOYS. Konkin, V. D.; Zhikhareva, V. I. Sb. Tr., Ukr. Nauch.-Issled. Inst. Metal., 9: 444-9(1964). (In Russian).

Conditions for the complexometric determination of cerium in combination with other rare earths, occurring in alloys for the modification of cast iron, are described. It was established that the titration of cerium proceeds best at pH 5.0 to 6.0 with indicator of Xylenol Orange and 1-(2-pyridylazo)-2-naphthol. The analytical process for the complexometric determination of magnesium was also worked out, along with conditions for its determination in iron and rare earths. The systematic analytical method for alloys containing cerium is faster than the analysis using common chemical methods and does not reduce the precision of the results obtained. (tr-auth)

25009 SOME CHROMOGENIC REAGENTS FOR THE LANTHANOIDS. Dey, Arun K.; Sinha, Surendra N.; Sangal, Satendra P.; Munshi, Kailash N. (Univ. of Allahabad, India). pp 151-62 of Spectra Symposium, Session S-1 and Spectra, Session S-2. Book One [of Preprints of] Fifth Rare Earth Research Conference, Aug. 30-Sept. 1, 1965.

The use of Alizarin Red S, Chromotrope 2B, 4-(2-pyridylazo) resorcinol, 2-(p-sulfophenylazo)-1,8-dihydroxynaphthalene-3,6-disulfonate, Thoron, Chrome Azurol S, Aluminon, and Xylenol Orange, as chromogenic reagents for the lanthanoids is described. They are sensitive, but not selective for rare earths. Xylenol Orange and 2-(p-sulfophenylazo)-1,8-dihydroxynaphthalene 3,6-disulfonate were found to be particularly suitable; the former was highly sensitive and the latter was more tolerant toward other cations. (auth)

25010 ADSORPTION INDICATORS IN THE TITRATIONS OF HEXACYANOFERRATE(II) AND OXALATE WITH THORIUM IONS. Dubey, P. S.; Tandon, K. N. (Univ. of Rajusthan, India). Talanta, 13: 765-6(May 1966).

Alizarin Red S, Pyrocatechol Violet, and Xylenol Orange are shown to be effective adsorption indicators for titration of hexacyanoferrate(II) and oxalate with thorium(IV) solution. The action of the indicators can be explained by the theory of surface compound formation. (auth)

25011 STUDY ON RAPID ANALYSIS BY RADIOACTIVATION. VII. DETERMINATION OF CHLORINE, BROMINE, RUBIDIUM, YTTRIUM, INDIUM, TUNGSTEN, GOLD AND LEAD BY NEUTRON IRRADIATION. Okada, Minoru. Tokyo Kogyo Shikensho Hokoku, 61: 7-10(Jan. 1966). (In Japanese).

The lower limits of detection for several elements were investigated by nondestructive determination using short-lived nuclides formed by neutron irradiation. The coefficient of variation of single analyses was obtained using unknown samples. The lower limit of detection for cases with an interfering activity after irradiation was obtained by use of synthetic samples. (auth)

25012 SCANDIUM PRECIPITATION AND SEPARATION FROM MANGANESE, NICKEL, COBALT, AND ZINC BY MEANS OF CINNAMIC ACID. Ostroumov, E. A.; Volkov, P. P. Tr. Inst. Okeanol., Akad. Nauk SSSR, 79: 75-80(1965). (In Russian).

It was established that scandium in weakly acid solutions in the presence of ammonium salts can be quantitatively precipitated by heating with ammonium cinnamate. The precipitate does not have a constant composition. The scandium is precipitated principally in the form of the neutral cinnamate salt $(C_6H_5CH:CHCOO)_3Sc$, which contains impurities of primary salts having anions as a function of the character of the solution (chloride, nitrate, or sulfate). The precipitate obtained can be reduced to Sc_2O_3 by heating. By precipitation using ammonium cinnamate, scandium can be separated from manganese, nickel, cobalt, and zinc. (tr-auth)

25013 SPECTROPHOTOMETRIC DETERMINATION OF TRACE AMOUNTS OF RARE-EARTH ELEMENTS IN PURE URANIUM. Yuan, Wei; Hsu, Chih-ku. Yuan Tzu Neng, No. 1, 18-26(1965).

Spectrophotometric analysis was used to study trace amounts of rare earths in pure uranium. Interferences of various elements were investigated and an analytical method was developed to determine 2 ppm of rare earth ions in a uranium compound weighing 1 g. Chloracetic acid at 1M concentration was used as a buffer solution. Instruments used were a spectrophotometer and an acidimeter. The buffer solution was regulated to have a dissociation constant of 1.6×10^{-3}, a pH value of 2.8, and a concentration of 0.04M. The extinction coefficient was found to decrease after 4 to 6 hr and become stable for 24 hr if a reducing reagent was added. Nd was used as a standard to prepare a calibration curve. It was found that Mg, Co, Ni, Cd, Mo, W, V, Sb, Mn, Ag, Be, Ru, Zn, and Hg have no interference effect. Nb, Sc, and Ta interfere severely. $Cr_2O_7^{=}$, MnO_4^{-}, and Sn^{2+} also interfere. A small amount of hydrogen peroxide produces no effect. Iron can be shielded by adding 10 to 30 mg ascorbic acid to 300 μg iron. Aluminum can be shielded by adding 0.008M sulfosalicyclic acid to 100 μg of aluminum in a 25 ml solution. Th produces the severest interference effect in rare earth analysis but can be shielded by adding PO_4^{3+}. TBP–CCl_4 in a hydrochloric acid solution was used to extract uranium. Fe, Nb, Ta, In, and Sc can also be extracted by this method, leaving only rare earth metals in the water phase. Experimental results showed that 1 g of uranium can be completely extracted by adding 40% TBP–CCl_4 and repeating the process 4 times. Rare earth and alkaline earth ions can be separated by using ammonium hydroxide with ferric hydroxide as a carrier. It was concluded that the sensitivity of the method is at 2 ppM and that the experimental error is 10%. (JPRS)

25014 STUDIES ON THE MICRODETERMINATION OF LITHIUM IN URANIUM BY FLAME PHOTOMETRY. Wang, Chin; Huang, Tsung-liang; Hsu, Ch'in-fang. Yuan Tzu Neng, No. 2, 109-16(1965).

Li was separated from uranium in concentrated HCl by the cation exchange method. Then, 0.4 to 3.6 mg Li/g U could be determined by flame photometry with benzene-air as the exciting source. Standard solutions were prepared by dissolving Li_2CO_3 in 9N HCl. In order to prevent interference from Ca, Sr, etc., 1 mg of Al and 1 ml of 3.6N H_2SO_4 were added to the solution. The presence of 50 μg of Mg, Ca, and Ba or 5 μg of Na, Ru, Cs, and Sr, respectively, in 0.2 μg of Li gave no interference in the determination. The presence of 5 μg of K or 50 μg of Cr(+3) gave errors of +5% and +10% in 0.2 μg of Li and +2% and +4% in 0.6 μg of Li, respectively. Admixture of other elements in Li gave even higher errors. Cr(+3) interference could be eliminated by oxidation with $HClO_4$, while that due to K was eliminated by subtracting the background at 671 μm. The recovery of Li in U was 95 to 103%. (ATD)

25015 THE SEPARATION AND DETERMINATION OF TRACE AMOUNTS OF URANIUM IN WASTE WATER. Ma, Hui-ch'ang; Ni, Che-ming. Yuan Tzu Neng, No. 2, 159-62 (1965).

By means of a 1.0 × 11 cm column, traces of uranium (less than 0.05 ppM) in heavily contaminated waste water could be concentrated with 3N HNO_3. The traces of uranium found in the eluate could then be determined colorimetrically with tributyl phosphate (TBP) after the pH was adjusted to about 6, and the actual amount of uranium could be determined by spectrophotometry. The presence of nitric acid and a small amount of free TBP had no significant undesirable effect on the determination. This method was found to be simple and time saving and did not require any chemical treatment before concentration. The accuracy of this method was found to be high when tested on samples that contained only 2.0 to 10.0 micrograms of uranium. The range of error was ≤0.3 micrograms. In addition to the various ions that are commonly found in waste water, 60 mg of F^{-}, 2.0 mg of Mn^{2+}, and 2.0 mg of V^{5+} did not impair the accuracy of this method. (ATD)

25016 THE DESIGN OF A URANIUM MICROANALYSIS OSCILLOSCOPE. Feng, Chien-hsing; Li, Hua-hsiang; Wang, Ya-chieh; Kuo, Hsien-ch'uan; Li, Wai-te (Nankai Univ., Tientsin, China). Yuan Tzu Neng, No. 4, 329-33 (1965).

A simple and high-quality microanalysis oscilloscope with a maximum range of detection of UO_2^{2+} ions down to 5.8×10^{-7}M is described. It consists of five components: a timing base, a mechanical synchronizing device, a horizontal and vertical sweeping circuit, and an electrolytic cell. The d-c voltage output from the cell is proportional to the UO_2^{2+} ion concentration at the vertical plate input through an r-c circuit and a two stage push-pull amplifier. The oscilloscope has two interchanging horizontal sweeping circuits; one from a d-c electrolytic cell, the other from a relaxation oscillator. Amplitude display is obtained by the first sweeping voltage and calibration by the second. A schematic diagram is given and each component of the oscilloscope is discussed. (ATD)

25017 GAS FLOW ACTIVATION AND AUTOMATIC RADIO-GAS CHROMATOGRAPHY OF COMPOUNDS WITH SHORT-LIVED NUCLIDES. Statnick, R. M.; Schmidt-Bleek, F. (Purdue Univ., Lafayette, Ind.). Z. Anal. Chem., 217: 321-32(1966). (In German).

An apparatus is described that can be used to study chemical effects of nuclear transformations with short-lived radioisotopes (^{13}N,^{15}O). The activity distribution of radiogaschromatograms is monitored automatically. The data readout is threefold: digital, analog (histogram on strip chart recorder, and directly into a computer formate presentation. The electronic off-time is not more than 40 μsec. Accurate halflife measurements over any length of time as well as the use of any counter type are possible. Moreover, the electronic equipment is suited for speeding up and simplifying the readout of all analytical tools presenting data in pulse form. (auth)

25018 X-RAY SPECTRAL ANALYSIS OF RARE EARTH ALLOYS. Rekhkolainen, G. I. Zavodsk. Lab., 32: 158-9(1966). (In Russian).

A method for the x-ray spectral determination of La, Ce, and Fe in misch metal and ferrocerium with preliminary dissolution of the sample is reported. For concentrations of La, Ce, and Fe of 15 to 50, 25 to 75, and 2 to 8%, respectively, a mean error of 4 to 5% was found. (tr-auth)

25019 LOCAL SPECTRAL ANALYSIS OF BERYLLIUM DIFFUSION IN MAGNESIUM. Erko, V. F.; Krasnorutskii, V. S. (Inst. of Physics and Technology, Academy of Sciences, USSR). Zavodsk. Lab., 32: 161-4(1966). (In Russian).

The diffusion of beryllium in magnesium at 500 to 600°C was measured using the method of local spectral analysis. The concentration sensitivity for the determination of beryllium in magnesium was approximately 4×10^{-3}%. The mean error of the method does not exceed ±10%. (tr-auth)

25020 DETERMINATION OF ISOTOPIC COMPOSITION OF HYDROGEN–TRITIUM MIXTURES BY THE METHOD OF EMISSION SPECTRAL ANALYSIS. Mosichev, V. I.; L'vov, B. V.; Khartsizov, A. D. Zh. Prikl. Spektrosk., 2: No. 1, 9-15(1965). (In Russian).

A photoelectric method is described for determining the isotopic composition of hydrogen-tritium mixtures from the atomic spectrum of hydrogen excited in a high-frequency discharge. Several discharge tubes were constructed of glass or quartz, with different ballast volumes ranging from 25 to 800 cm^3. Use of the ballast volume eliminated distortion of the results caused by adsorption of hydrogen by the walls of the tube during the discharge. The spectra were excited with a high-frequency generator (145 Mcs, ~30 W), and a spectrograph was used to record the intensities of the isotopic components H_β 4861.33 Å and T_β 4859.61 Å. The rms error of a single determination was 1.5 to 2.2% of the concentration of the isotope with the smaller content. The validity of the assumption that the intensity ratio of the tritium and hydrogen line is equal to the ratio of their concentrations was studied. The following formula was developed for the calculation of the isotopic composition

$$C_T(\text{at. \%}) = \frac{100}{1.03\ (I_H/I_T)_{max} + 1}.$$

This holds true for the concentration interval from 0.2 to 99.8% for one of the isotopes. The duration of the analysis is 30 min. After the end of the analysis the sample can be used for its initial purposes. (ATD)

25021 ORGANIC COPRECIPITANTS. PART 19. COPRECIPITATION OF CURIUM IN THE FORM OF CHELATES. Kuznetsov, V. I.; Akimova, T. G.; Eliseeva, O. P. pp 44-9 of Radiokhimicheskie Metody Opredeleniya Mikroelementov. Moscow-Leningrad, Izdatel'stvo Nauka, 1965. (In Russian).

The concentration of curium (^{242}Cm) in the form of chelates with organic coprecipitants is described. Curium-242, an α emitter, was determined radiometrically with an α counter. At pH $\simeq$ 4–4.75, curium precipitated almost quantitatively with the precipitate formed by arsenazo and crystal violet even from solutions with a dilution as low as $1:1 \times 10^{18}$ (2×10^{-8} γ cm in 20,000 ml). A complete coprecipitation of curium when other chelating agents were used in combination with crystal violet took place at pH ~ 2.5–8.5 (arsenazo II), ~1–6 (arsenazo III and 4,4′-biphenyl-3,3′-dicarboxy-bis[(2-azo)-1,8-dihydroxy-3,6-naphthalene-disulfonic acid]). Reagents having molecules of larger size coprecipitated curium over a wider pH range than did structurally similar reagents with smaller molecules. Coprecipitation with the precipitate formed by arsenazo and crystal violet at pH 4.5 permits the separation of curium from magnesium present in amounts 10^{11} times as high. (CFSTI)

25022 GAS CHROMATOGRAPHIC Xe-Kr SEPARATION AND SOME NUCLEAR DATA ON ^{90}Kr. Lepold, M. F. Karlsruhe, Ger., Technische Hochschule, 1965. 65p. $2.00 Gmelin, AED-Diss. 65-236.

The constants in Langmuir's adsorption isotherms for Kr and Xe on charcoal were determined with tracer methods. A system for production, separation, and investigation of short lived fission products is described. Decay data of ^{90}Kr are given. (Gmelin Inst.)

25023 DUAL PATH COLORIMETER (Engineering Materials). (Rocky Flats Div., Dow Chemical Co., Golden, Colo.). (CAPE-1335).

4 drawings.

The filter photometer described uses a cadmium sulfide photoconductive cell as the light-sensing device and was designed for maximum utility in glove-box operations and remote monitoring. It is a single-beam instrument used primarily for ion-column solution analyses. The cell is a stainless steel tube with circular glass windows gasketed with Teflon, and it is capable of withstanding 50-psi solution pressure. The polarizing voltage on the cell is supplied by an 85-v regulated power supply, and a constant voltage transformer is used for the lamp power supply. A 4-wire cable connects the electronic chassis and the sensing unit. This instrument can be used as a photometric titrator by redesigning the sensing unit for a titration cell, and it can also be used as a laboratory filter photometer when lamps having greater illumination intensities are used. (For details, see TID-4100.) (M.C.G.)

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Refer also to abstracts 25478 and 26384.

25024 (AERE-R-5097, Paper 6) PREPARATION OF EVAPORATED TARGETS. Erne, F. C. (Utrecht Rijksuniversiteit (Netherlands)). 3p.

Enriched targets for particle bombardment in the form of a chemical compound are preferably evaporated in the laboratory not long before the experiment. A device used for evaporation consists essentially of a small tantalum tube surrounded by a thin tantalum foil for indirect heating and supported by tungsten wires. Foils or backings on which each material is evaporated are selected to prevent chemical reactions with the backings and strongly competing nuclear reactions. Care should be taken to be sure that the composition of the material after evaporation is the same as before evaporation. (A.G.W.)

25025 (AERE-R-5097, Paper 12) THE PREPARATION OF SAMPLES BY ELECTROCHEMICAL METHODS. Verdingh, V. (European Atomic Energy Community, Geel (Belgium). Central Nuclear Measurements Bureau). 8p.

Three electrochemical methods of sample preparation are described briefly: electrodeposition, electrospraying, and electrophoretic deposition. By electrodeposition, the element is deposited in its metallic state and deposits of different thicknesses can be made on a variety of backings. A sample can be prepared from one drop of solution by micro-electrolysis. Ammonium oxalate and EDTA were studied as electrolytes for Pu and U deposition. Electrospraying was especially used for isotopes of U, Pu, Am, B, Li, Co, Ni, and Cu. Compounds of the element are deposited, but only a very small quantity of the element is required. Electrophoretic deposition was used for larger quantities of material up to 12 mg/cm^2 and even more. (A.G.W.)

25026 (AERE-R-5097, Paper 16) MOLECULAR PLATING: PREPARATION OF SELF-SUPPORTING FILMS. Parker, W.; Gullholmer, W. (Chalmers Tekniska Hogskola, Goteborg (Sweden)). 3p.

An electrodeposition method previously used for preparing electron microscope specimens was extended to the preparation of larger films (0.5 cm^2) suitable for measurements of nuclear reactions. The apparatus is described and a detailed procedure is given for preparing films from a solution of uranyl nitrate. The method appears to be applicable to all compounds so far plated by the usual molecular plating process. (A.G.W.)

25027 (AERE-R-5097, Paper 17) MOLECULAR PLATING: PREPARATION OF CARBON AND SULPHUR SAMPLES AND TARGETS. Gullholmer, W.; Parker, W. (Chalmers Tekniska Hogskola, Goteborg (Sweden)). 2p.

Molecular plating was applied to the preparation of thin targets and radioactive samples of carbon and sulfur. In both cases the material was codeposited with sodium as Na_2CO_3 and Na_2SO_3. The electrodeposition cell is illustrated. An aluminum cathode was used for sample preparation and a tantalum cathode for target preparation. The deposition efficiency was found to be strongly dependent on the cathode material and was 32 and 17% for Al and Ta respectively for a deposition time of 30 min. The deposits obtained had good uniformity and mechanical stability. (A.G.W.)

25028 (AERE-R-5097, Paper 18) PREPARATION OF THIN ^{17}O AND ^{18}O TARGETS. Muggleton, A. H. F. (Atomic Weapons Research Establishment, Aldermaston (England)). 5p.

A technique for preparing thin ^{17}O and ^{18}O targets consists essentially of producing a suitable compound enriched in the oxygen isotope and vacuum evaporating the compound to prepare the target. Attempts to prepare tungsten oxide from D_2O enriched in the desired oxygen isotopes resulted in oxides containing a high percentage of ^{16}O. Preparation of tungsten oxides from enriched oxygen gas was more successful. The tungsten oxide was evaporated from a Pt boat. Films up to 500 μg/cm^2 were deposited on self-supporting carbon backings. The targets had enrichments of >40% from 51% enriched $^{17}O_2$ and 90 ± 10% from 99.6% $^{18}O_2$. (A.G.W.)

25029 (AERE-R-5097, Paper 19) A METHOD FOR THE PREPARATION OF THIN, SELF-SUPPORTING ^{13}C FOILS. Muggleton, A. H. F. (Atomic Weapons Research Establishment, Aldermaston (England)). 4p.

In the technique described, methyl iodide enriched in the carbon isotope is thermally decomposed onto a thin Ni foil. The Ni is then dissolved in acid. Satisfactory self-supporting foils up to 100 μg/cm^2 of both ^{13}C and ^{14}C were made by this technique. The apparatus used is illustrated. (A.G.W.)

25030 (AERE-R-5097, Paper 28) CONTINUOUS OBSERVATION OF ACTINIDE ELECTRODEPOSITION. Barnett, G. A.; Crosby, J.; Ferrett, D. J. (Atomic Energy Establishment, Winfrith (England)). 8p.

An electrodeposition apparatus is described, which gives chart recorder profiles of α activity as it builds up on the cathode during deposition. Changes in the deposition rate as a function of changed electrolyte or cell parameters can thus be observed immediately. The thin-end-window cathode technique is used, in which short-range radiation passing through the very thin metallic foil electrode is continuously monitored by an adjacent detector. Examples are shown of the electrodeposition of ^{231}Pa, ^{239}Pu, ^{237}Np, ^{233}U, ^{238}U, and ^{243}Am. (A.G.W.)

25031 (ANL-7146) A METHOD FOR COMPUTER ANALYSIS OF THE FORMATION CURVE OF A TRANSIENT, WHERE CONCURRENT REACTIONS CAUSE CONSUMPTION OF THE TRANSIENT. Sauer, Myran C. Jr. (Argonne National Lab., Ill.). Jan. 1966. Contract W-31-109-eng-38. 26p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

A method is presented for the computer analysis of data on the concentration of B vs time where the reactions occurring are: A → B, B + B → BB, B + A → BA, A + A → AA, A → C, C + A → CA, C + B → CB, and C + C → CC. The analysis yields a value for $k_1 + k_5$. (auth)

25032 (BM-RI-6781) HIGH-TEMPERATURE HEAT CONTENTS AND ENTROPIES OF TWO PRASEODYMIUM OXIDES AND THREE TERBIUM OXIDES. Pankratz, L. B. (Bureau of Mines, Washington, D. C.). 1966. 9p. Bureau of Mines Free.

High-temperature heat contents were measured for two praseodymium oxides and three terbium oxides. These were: Pr_2O_3 (298° to 1,600°K), $PrO_{1.833}$ (298° to 1,050°K), Tb_2O_3 (298° to 1,600°K), $TbO_{1.719}$ (298° to 880°K), and $TbO_{1.812}$ (298° to 850°K). With the exception of $PrO_{1.833}$, all results were regular. $PrO_{1.833}$ had a small thermal anomaly at 760°K with an extra absorption of 380 cal/mole. The measured heat content values, tabulated smooth heat contents, and entropy increments are reported. Heat content equations were derived. (auth)

25033 (CEA-R-2842) L'APPLICATION DES PROPRIETES CHIMIQUES DU RUTHENIUM A DES PROCEDES DE DECONTAMINATION. (Application of the Chemical Properties of Ruthenium to Decontamination Processes). Fontaine, Andre; Berger, Danielle (Commissariat a l'Energie Atomique, Chusclan (France). Centre de Production de Plutonium de Marcoule). Dec. 1965. 78p. Dep. mn.

The chemical properties of ruthenium in the form of an aqueous solution of the nitrate and in organic tributyl phosphate solution were reviewed. From the data obtained, some known examples are given to demonstrate the processes of separation or of elimination of ruthenium from radioactive waste. (auth)

25034 (IFA-IS-35) TABULATED VALUES OF THERMAL DIFFUSION FACTORS FOR VARIOUS ISOTOPIC GASEOUS MIXTURES. Vasaru, Gh. (Institutul de Fizica Atomica, Academia R. P. R., Bucharest (Romania)). 1966. 36p. Dep. mn.

Using previously determined data, detailed calculations for thermal diffusion (TD) factor versus temperature (T) were performed for various isotopic gaseous mixtures of H, He, C, N, and O. (P.C.H.)

25035 (JINR-D-2710) CHEMICAL PROPERTIES OF ELEMENT 104. Zvara, I.; Chuburkov, Yu. T.; Caletka, R.; Zvarova, T. S.; Shalayevsky, M. R.; Shilov, B. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1966. 5p. Dep. mn.

Using the method of fast continuous separation of the elements of subgroups III B and IV B, the properties of Cm, Cf, Hf, and $^{260}104$ chlorides were compared. Up to now, the isotope of element 104 has been identified by physical methods only. Now it was found that its chemical properties are different from those of actinide elements and close to Hf. The atomic number of the new nucleus was independently confirmed. It was also found that element 104 belongs to group IV. Twelve atoms of $^{260}104$ were detected. (auth)

25036 (RFP-728) PROCESS STUDIES ON THE REDUCTION OF PLUTONIUM TETRAFLUORIDE TO METAL. Conner, W. V. (Rocky Flats Div., Dow Chemical Co., Golden, Colo.). May 11, 1966. Contract AT(29-1)-1106. 25p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Studies were made to determine the factors that affect the reduction of plutonium tetrafluoride to plutonium metal using calcium as the reductant. It was found that the degree to which the calcium and plutonium tetrafluoride reactants are mixed has no affect on the reduction yield. A good metal yield can be obtained from an unmixed charge if the plutonium tetrafluoride is placed on top of the calcium. If, however, the plutonium tetrafluoride is placed in the bottom of the reaction vessel, a poor metal yield will result. It is possible to eliminate the problem of the reduction charge being prepared with plutonium tetrafluoride in the bottom of the reaction vessel by using a divided hopper to prepare the charge. It was also found that a good correlation exists between the chemical composition of the plutonium tetrafluoride used in a reduction charge and the reduction yield. (P.C.H.)

25037 (TRG-Report-1119) THE EQUATION OF STATE OF URANIUM DIOXIDE AT HIGH TEMPERATURES AND PRESSURES. Menzies, D. C. (Reactor Group, United Kingdom Atomic Energy Authority, Dounreay (Scotland)). Feb. 7, 1966. 16p. Dep. BIS $0.50. HMSO 2s. 6d.

The equation of state of uranium dioxide was derived by the method of corresponding states from the tabulated universal data of Hougen, Watson and Ragatz (Chemical Process Principles, Pt II., sec. ed.). The results are presented in the form of tables, graphs, and empirical relations which fit the data in the regions of interest to studies of fast reactor accidents. Results cover temperatures up to 20,000°K and pressures up to 20,000 atm. (auth)

25038 CRYSTAL DATA FOR YTTERBIUM ORTHOFERRITE $YbFeO_3$. Harrison, F. W. (Mullard Research Labs., Surrey, Eng.). Acta Crystallogr., 20: 699-700 (May 10, 1966).

Powder data from ytterbium orthoferrite, $YbFeO_3$, are reported. The data were obtained from a single crystal approximately a millimeter cube. The lower-angle lines were indexed on the basis of an orthorhombic cell of space group Pbnm (D_{2h}^{16}). The lines 132, 024, and 204, which were unequivocally indexed, were used to determine lattice constants a = 5.22, b = 5.54, and c = 7.56 A. Calculated and observed d spacings are given. (F.J.H.)

25039 ON THE PERTURBATIONS IN THE SPECTRA OF TlH AND TlD. Larsson, Tor; Neuhaus, Hinrek (Stockholm Univ.). Ark. Fys., 31: 299-305(1966).

The $^1\Pi - X^1\Sigma^+$ transition in TlD was studied in an attempt to find the forbidden $^3\Pi_2 - X^1\Pi^+$ transition, previously observed in TlH and presumably brought about by a perturbation. In the $^1\Pi$ state of TlD another perturbation was found, however, which led to a general discussion of all the known perturbations in the spectra of both molecules. The newly found perturbation was interpreted as causing a predissociation of Mulliken's type c^-. (auth)

25040 ABSORPTION SPECTRA OF SILVER HYDRIDE AND SILVER DEUTERIDE IN THE FAR ULTRAVIOLET. Ringstroem, Ulf; Aslund, Nils (Univ. of Stockholm). Ark. Fys., 32: 19-64(1966).

The absorption spectra of silver hydride (AgH) and silver deuteride (AgD) were studied in the region 2200-2500 Å. 19 bands were analyzed for the hydride, 20 for the deuteride, going to 5 excited electronic states: $B^1\Sigma^+$, $C^1\Pi$, $D^1\Pi$, $b^3\Delta_1$ and $c^3\Pi$. With one exception all the vibrational levels found in these states are perturbed, both in AgH and AgD. From the perturbations one can infer the existence of an $a^3\Pi$ and a $d^3\Sigma^+$ state. $B^1\Sigma^+$ has earlier been inferred from the strong perturbations of $A^1\Sigma^+$. There are no evident signs

in $B^1\Sigma^+$ for this perturbation, which indicates that the whole potential curve has been displaced. The 2-2 band of C–X in AgH and the bands to v = 0 of b in AgH and AgD show intensity anomalies, the former having no R branch and a weak Q branch, the latter having very weak P branches. The anomalies are due to an interaction of the C- and b-levels in question, but other states are also involved. A detailed explanation is not, however, given. The $a^3\Pi$ state is regular with the coupling constant $A \geq 150$ cm^{-1}, while $c^3\Pi$ is inverted. For slow rotation, a must have almost entirely Hund's case a coupling. There is, however, a perturbation of $B^1\Sigma^+$ by $a^3\Pi_2$, which should not occur according to the theory if a were of pure case a coupling. Of the $c^3\Pi$ state, $c^3_0\Pi_0$ and $c^3_1\Pi_1$ have been found in AgH, $c^3_1\Pi_1$ and $c^3_2\Pi_2$ in AgD. The fact that c_{0^-}–X and c_2–X do appear must be ascribed to the coupling conditions in the c state. B, D, b, c (and d?) are derived from Ag(^{2}D), A, C and a from Ag(^{2}P), and X from Ag(^{2}S). The states in the first group are more weakly bound than the others and are derived from the atomic term with largest multiplet splitting. Atomic J quantization may therefore persist to a great extent in the molecule for these states. The appearance of the above-mentioned bands must be ascribed to the atomic J vector or to the total spin being uncoupled from the internuclear axis. The dissociation energy for the ground state can be estimated by Birge-Sponer extrapolation from already known data (Gerö and Schmid, 1943). One finds that $D_e \simeq 20{,}300$ cm^{-1}. Constants for all the states of AgH/AgD are given. The electron configuration for the ground state is KLMNspd $(5s\sigma)^2$, or, shortly, $(d^{10})(5s\sigma)^2$. For the excited states the following configurations are proposed: $(d^{10})(5s\sigma)(5p\sigma)$, $^1\Sigma^+$,$^3\Sigma^+$ $A^1\Sigma^+$; $(d^{10})(5s\sigma)(5p\pi)$, $^1\Pi$,$^3\Pi_r$ $C^1\Pi$,$a^3\Pi$; $(d\sigma)^2(d\pi)^4(d\delta)^3(5s\sigma)^2(5p\sigma)$, $^1\Delta$,$^3\Delta_i$ $b^3\Delta_1$; $(d\sigma)^2(d\pi)^3(d\delta)^4(5s\sigma)^2(5p\sigma)$, $^1\Pi$,$^3\Pi_i$ $D^1\Pi$,$c^3\Pi$; and $(d\sigma)(d\pi)^4(d\delta)^4(5s\sigma)^2(5p\sigma)$, $^1\Sigma^+$, $^3\Sigma^+$ $B^1\Sigma^+$,$d^3\Sigma^+$. (auth)

25041 SPECTRA OF COPPER HYDRIDE AND COPPER DEUTERIDE. Ringstroem, Ulf (Univ. of Stockholm). Ark. Fys., 32: 211-39(1966).

The absorption spectra of copper hydride (CuH) and copper deuteride (CuD) were studied in the region 3300–3900 Å. 11 new bands were analyzed for the hydride, 16 for the deuteride, going to 6 excited electronic states: $A^1\Sigma^+$, $B^3\Pi_{0+}$, Cl, cl, $a^3\Sigma^+$ and $b\Delta_2$. A, B, C and c are known from earlier investigations. v = 0 of cl was earlier attributed to a $^1\Pi^{**}$ state (Heimer, 1937). v = 0 and 1 of Cl were labelled by Heimer v = 0 and 1 Cl were labelled by Heimer v = 0 of two different states, $^1\Pi^*$ and $^1\Pi^{***}$. One of Cl, cl is a $^1\Pi$, the other a $^3\Pi_1$, but it cannot be settled which is which. One band of $a^3\Sigma^+$–$X^1\Sigma^+$ was found for CuD. It shows simple R and P branches, whereas according to the theory two R and two P branches are expected for non-vanishing spin-splitting, which is probable in the case of CuH/CuD. It seems then as if only the N = J component of the $^3\Sigma^+$ participates in the transition from the ground state. $a^3\Sigma^+$ perturbs many of the vibrational levels of the other excited states, both in CuH and CuD. $b\Delta_2$ was observed in CuH through perturbations by Cl. The multiplicity cannot be ascertained. c – X 1 – 0 in CuH and c – X 2 – 0 in CuD show only R and Q branches. In CuH v = 1 of cl is perturbed heavily by v = 2 of $B^3\Pi_{0+}$, and the band B – X 2 – 0 shows a very weak R branch. The dissociation energy of the ground state is estimated to be $D_e = 23{,}000 \pm 500$ cm^{-1} (2.85 ± 0.06 ev). Constants for all the states of ^{63}CuH/^{63}CuD are given. (auth)

25042 ON THE B–X BAND SYSTEM OF BaD. Kopp, Ingvar; Wirhed, Rolf (Univ. of Stockholm). Ark. Fys., 32: 307-20(1966).

The $B^2\Sigma$–$X^2\Sigma$ band system of BaD in the region 8000–10,000 Å was studied in absorption using a King furnace and a 10.685 meter concave-grating spectrograph. Computer methods were applied to calculate term values and to fit energy formulas to these term values. The large spin-splitting constant of the B state is in close agreement with the theoretical value obtained assuming that a pure precession relation exists between the B state and the $A^2\Pi$ state. From this it is concluded that the dissociation of the A and B states would have led to Ba(^{3}P) + H(^{2}S) if interaction with a $^2\Sigma$ and a $^2\Pi$ state derivable from Ba(^{3}D) + H(^{2}S) had not been taken into account. It is thus proposed that the dissociation of the A and B states leads to Ba(^{3}D) + H(^{2}S), giving a dissociation energy of the B state of about 14,500 cm^{-1}. (auth)

25043 BAND SPECTRA OF YbH AND YbD. Hagland, Lennart; Kopp, Ingvar; Aslund, Nils (Univ. of Stockholm). Ark. Fys., 32: 321-69(1966).

The spectrum of YbH was generated both in emission and in absorption, whereas the spectrum of YbD was generated only in emission. A quartz discharge tube served as a light source in obtaining the emission spectra. The absorption spectrum was obtained by means of a King's furnace. Most of the spectrograms were taken using an 11 meter concave grating spectrograph. The observed bands were analyzed as transitions between the upper states $D^2\Pi$, $E^1/_2$, and $F^1/_2$ and the $X^2\Sigma$ ground state. Three other states were observed by perturbations, namely, $A^2\Pi$, $B^1/_2(^2\Sigma)$, and $C^2\Delta$. A computer method for the picking out of branches is presented. All constant determinations were based on term values. Energy formulas were fitted to the term values and the constants derived for YbH are given. From predissociation effects the ground state dissociation energy is estimated to be 13,100 cm^{-1}. (auth)

25044 ROTATIONAL ANALYSIS OF THE A–X BAND SYSTEM OF BaH AND BaD. Kopp, Ingvar; Kronekvist, Mona; Guntsch, Arnold (Univ. of Stockholm). Ark. Fys., 32: 371-405(1966).

The absorption spectra of BaH and BaD in the region 9200–11200 Å were studied by means of an 11 meter concave grating spectrograph. A King furnace was used to produce the spectra. The A $^2\Pi$–X $^2\Sigma$ band system of the two molecules was analyzed. A new state, probably a $^2\Delta$ state denoted H, was observed by perturbations of the A levels. Computer methods were used to calculate term values and to fit energy formulas to these term values. The constants derived for BaH are tabulated. The constants A and A_J were also derived for the BaD A $^2\Pi$ v = 1 and v = 2 levels (cm^{-1}). (auth)

25045 ANALYSIS OF COMPLEX NEODYMIUM COMPOUNDS USING XYLENOL ORANGE. Akhmedli, M. K.; Alieva, S. R. Azerbaidzh. Khim. Zh., No. 6, 134-7(1965). (In Russian).

Conditions for the formation of complex compounds of neodymium with potassium suboxide, KO, were investigated and the molar coefficients of extinction and the constants of some of the complexes were calculated. The complex and reagents are stable with time, and the complex compounds obtained obey the Lambert-Beer Law. It was established that the components interact in the ratio (Nd^{3+}) : (KO) = 1:1. Electromigration and chromatography showed that the complexes have no charge. (tr-auth)

25046 PREPARATION OF SAMARIUM PHOSPHIDES. Tikhonova, N. N. (Inst. of Problems of Material Studies, Academy of Sciences, Ukrainian SSR). Azerbaidzh. Khim. Zh., No. 6, 139-41(1965). (In Russian).

Studies showed that samarium phosphide is easily formed from the oxide at very high temperatures. (tr-auth)

25047 ADDITION REACTIONS INITIATED BY RADIATION. V. ADDITION ALKYL PHOSPHITES ON ALKENES. Rabilloud, Guy (Centre d'Etudes Nucleaires, Grenoble, France). Bull. Soc. Chim. France, No. 3, 1145-8(Mar. 1966). (In French).

The radiochemical addition of alkyl phosphites and in particular methyl phosphite on the ethylene double bond makes it possible to prepare a large number of alkylphosphonates with a high yield. The chain reaction was developed under conditions such that formation of the 1/1 addition products predominate even with alkenes with an internal double bond. (tr-auth)

25048 REMARKS ON THE DIFFERENT CRYSTALLINE TRANSFORMATIONS PRESENTED AT HIGH TEMPERATURES BY RARE EARTH SESQUIOXIDES. Foex,

Marc; Traverse, Jean-Pierre (Centre National de la Recherche Scientifique, Montlouis, France). Compt. Rend., Ser. C, 262: 636-9(Feb. 21, 1966). (In French).

An attempt was made to define the areas of existence of different crystalline forms of rare earth sesquioxides. The case of the B monoclinic–C cubic crystalline transformation was examined. (tr-auth)

25049 THE HYDRATES OF URANIUM CHLORIDE. IV. TWO EXCEPTIONAL PHENOMENA: PERITECTICS WITH GLASS AND MULTIPLE VITRIFICATION. Chretien, Andre; Pommier, Claude (Chaire de Chimie Minerale de la Sorbonne, Paris). Compt. Rend., Ser. C, 262: 644-7(Feb. 21, 1966). (In French).

Four hydrates of the system UCl_4-H_2O-HCl were identified as solid phases in the temperature range between 0 and 40°C for 9, 7.5, 5, and 4.5 H_2O through thermal differential analysis and by solubility measurements. A phase diagram for the ice branch of the nonahydrate is given that shows a peritectic point at −45°C. The phenomena that occur on freezing and on reheating of this nonahydrate are discussed. (G.O.Y.)

25050 THE APPARENT EXISTENCE OF A COMPLEX ION $Ln_2O_2^{2+}$ OR LnO^+ IN NUMEROUS RARE EARTH COMPOUNDS. Caro, Paul (Arizona State Univ., Tempe). Compt. Rend., Ser. C, 262: 992-5(Mar. 21, 1966). (In French).

The examination of known structures of some oxygenated compounds of the rare earths led to the supposition of the existence of a complex group $Ln_2O_2^{2+}$ or LnO^+ for which the distance Ln–O is abnormally short. It is suggested that this group constitutes a complex ion possessing its own salts. Some anomalies (nephelauxetic effect) observed in the optical spectrum of some of these compounds supported the hypothesis of an Ln–O bond of the covalent type. (tr-auth)

25051 ADDUCTS OF LANTHANON CHLORIDES WITH DIMETHYL SULFOXIDE. Ramalingam, S. K.; Soundararajan, S. (Indian Inst. of Science, Bangalore). Curr. Sci. (India), 35: 233(May 5, 1966).

Seven dimethyl sulfoxide (DMSO) complexes of rare earth and yttrium chlorides were prepared, isolated, and characterized. Analyses indicated that the complexes conform to the formula $Ln(DMSO)_nCl_3$ where: Ln = Ce, Gd, La, Nd, Pr, and Sm, n = 4; and Ln = Y, n = 3. The complexes are insoluble in nonpolar solvents and soluble in polar solvents. Conductivity and infrared data are given. (F.J.H.)

25052 DETERMINATION OF THE ENERGY TRANSPORT VELOCITY CONSTANTS IN CHELATES OF COMPLEX RARE-EARTH IONS. Ermolaev, V. L.; Aleshin, V. G.; Saenko, E. A. Dokl. Akad. Nauk SSSR, 165: 1048-51(Dec. 11, 1965). (In Russian).

A method is described for the determination of the rate constant of nonradiative transfer of electron energy from a ligand to a rare-earth molecule for complexes of dibenzoylmethanate (DBM) with Sm^{3+} and Eu^{3+} and for acetylacetonate (AA) with Sm^{3+}, Eu^{3+}, Tb^{3+}, and Dy^{3+}. The method is based on the competition between the intramolecular ligand-rare earth transfer and the intermolecular energy transfer over the triplet states of organic ligand-quencher (acceptor) compounds. The quenchers used were naphthalene for AA and acridine, anthracene, 1,2-benzanthracene, and pyrene for DBM. The rare-earth complex luminescence was excited outside the absorption band of the quencher (3340 Å for AA and 4050 Å for DBM). The measurements were made in toluol at 293°K. Plots are presented of the electronic levels in triplet-triplet quenching, of the phosphorescence spectra of the ligand and of the rare earth and of the behavior of the luminescence quenching agent. The results show that the intermolecular triplet-triplet energy transfer between organic molecules has a higher rate constant than the ligand-rare earth transition, which has a higher order of forbiddenness. The application of the results to an analytic determination of the content of rare earths by means of the luminescence of rare-earth-complex residues is briefly discussed. (ATD)

25053 INVESTIGATION OF THE $Gd_2O_3-Al_2O_3$ AND $Sm_2O_3-Al_2O_3$ SYSTEMS. Budnikov, P. P.; Kushakovskii, V. I.; Belevantsev, V. S. Dokl. Akad. Nauk SSSR, 165: 1075-7(Dec. 11, 1965). (In Russian).

The interaction between aluminum oxide and the oxides of samarium and gadolinium below the solidus temperature were studied. Mixtures were prepared by coprecipitation of ammonium from a nitric acid solution of aluminum and gadolinium (samarium) hydroxides with subsequent annealing at various temperatures. A table is given showing data from x-ray phase analysis of these mixtures. The results show that the reaction for formation of $SmAlO_3$ ends at 880°. In the $Gd_2O_3-Al_2O_3$ system, formation of the compound $GdAlO_3$ passes through a new phase with an unknown structure. Traces of this phase remain even after annealing at 1380°. Analysis of the specimens showed that aluminum oxide is not noticeably soluble in $GdAlO_3$ and $SmAlO_3$. It was found that new chemical compounds are formed in annealed alloys containing more than 50 mol % of rare earth oxide. Microstructural analysis shows that a single phase structure arises in compositions containing about 66 mol % of the rare earth oxide. The composition of the new compounds give chemical formulas of $2Gd_2O_3 \cdot Al_2O_3$ and $2Sm_2O_3 \cdot Al_2O_3$. These compounds melt and decompose at 1950° and 1920° respectively. X-ray analysis of the newly synthesized compounds shows that the formation of $GdAlO_3$ perovskite at low temperatures passes through the 2 : 1 phase. The new compounds have no noticeable region of homogeneity. Both the 1 : 1 and 2 : 1 phases are in equilibrium in the range of compositions containing 50–66 mol % of the rare earth oxide. Phase diagrams are given for the $Gd_2O_3-Al_2O_3$ and $Sm_2O_3-Al_2O_3$ systems. (ATD)

25054 HYDRAZINIUM HEPTAFLUOROURANATE (V). PREPARATION, PROPERTIES, AND THERMAL DECOMPOSITION. Frlec, B.; Brcic, B. S.; Slivnik, J. (Nuclear Institute Jozef Stefan, Ljubljana). Inorg. Chem., 5: 542-6 (Apr. 1966).

The compound, hydrazinium heptafluorouranate(V), was prepared at 0°C by the reaction of hydrazinium difluoride and uranium hexafluoride both in anhydrous hydrogen fluoride and in carbon tetrachloride. The magnetic moment of the yellowish compound at 0°C is 1.66 BM. X-ray powder-diffraction data are given. The thermal decomposition of the compound in an inert atmosphere proceeds as follows: $N_2H_6UF_7 \rightarrow N_2H_6UF_6 + UF_4 \rightarrow N_2H_5UF_5 + UF_4 \rightarrow 3UF_4 \cdot HF \rightarrow UF_4$ from 70 to 380°C. A detailed discussion of this thermal decomposition is given. (auth)

25055 SYNTHESIS AND X-RAY PROPERTIES OF ALKALI FLUORIDE-PROTACTINIUM PENTAFLUORIDE COMPLEXES. Asprey, L. B.; Kruse, F. H.; Rosenzweig, A.; Penneman, R. A. (Los Alamos Scientific Lab., N. Mex.). Inorg. Chem., 5: 659-61(Apr. 1966).

Complex fluorides containing pentavalent protactinium and alkali fluoride were prepared from aqueous hydrofluoric acid solutions and also by fluorine oxidation of intimately ground, stoichiometric mixtures of PaF_4 and alkali fluoride. Formed by these reactions are complexes of the $MPaF_6$ type where M = Li, Na, K, Rb, Cs, and NH_4. The crystalline $MPaF_6$ compounds containing the larger cations (K, Rb, Cs, and NH_4) are orthorhombic, while $NaPaF_6$ is tetragonal. None of the six $MPaF_6$ complexes is isostructural with its tantalum analog. Cell dimensions for these seven compounds are given. Properties of some higher complex fluorides are also given. (auth)

25056 PREPARATION OF PRASEODYMIUM TETRAFLUORIDE. Soriano, J.; Givon, M.; Shamir, J. (Israel Atomic Energy Commission, Yavne. Hebrew Univ., Jerusalem). Inorg. Nucl. Chem. Lett., 2: 13-14(Jan. 1966).

The complex salt, Na_2PrF_6, was prepared by fluorination of Na_2PrCl_5. Analyses indicated that all the praseodymium in the complex salt was in the tetravalent state. The compound was placed in a dry box and anhydrous hydrogen fluoride distilled on the compound. The liquid hydrogen fluoride decomposed the complex according to the reac-

tion: $Na_2PrF_{6(s)} + 2HF(l) \rightarrow 2NaHF_2(soln) + PrF_4(s)$. The final product obtained was a mixture of 40% PrF_4 and 60% PrF_3. (M.C.G.)

25057 DENSITY OF MOLTEN ThF_4; INCREASE OF DENSITY ON MELTING. Cantor, S.; Hill, D. G.; Ward, W. T. (Oak Ridge National Lab., Tenn.). Inorg. Nucl. Chem. Lett., 2: 15-18(Jan. 1966). (ORNL-P-1931).

The density of molten ThF_4 was determined at 1119 to 1235°C. The data fit the equation $d(g/cm^3) = 7.101 - 8.08 \times 10^{-4}$ (°C). The melt was apparently denser than the solid at the melting point. The density of the solid at the melting point was calculated to be 6.13 g/cm^3. The density of the liquid at the melting point was 6.20 g/cm^3. (M.C.G.)

25058 ALKALI FLUORIDE COMPLEXES OF PENTAVALENT NEPTUNIUM. Asprey, L. B.; Keenan, T. K.; Penneman, R. A.; Sturgeon, George D. (Univ. of California, Los Alamos, N. Mex.). Inorg. Nucl. Chem. Lett., 2: 19-21(Jan. 1966). (LA-DC-7698).

By treating alkali fluoride-NpF_4 compounds with fluorine at elevated temperatures, $CsNpF_6$ and Rb_2NpF_7 were prepared. X-ray powder diffraction data showed that $CsNpF_6$ is rhombohedral and that Rb_2NpF_7 is monoclinic. The photographs also indicated that both compounds were formed as a pure phase. The observed d-spacings for several of the strongest lines are listed. (M.C.G.)

25059 CRYSTAL GROWTH IN THE Pr_2Se_3–I_2 SYSTEM. Kalitin, V. I.; Yarembash, E. I. (Inst. of General and Inorganic Chemistry, Academy of Sciences, USSR). Izv. Akad. Nauk SSSR, Neorg. Mater., 1: 2170-7(Dec. 1965). (In Russian).

The possibility of the growth of monocrystals of Pr_2Se_3 and $PrSe_2$ from the gaseous phases in $Pr_2Se_3-I_2$ systems by diffusion transfer was established with temperature drops from 900 to 700°C or 950 to 650°C. The optimum concentration of carrier iodide for production of the crystals of the proper form was 2 to 3 mg/cm^3. The reaction projected in the system $Pr_2Se_3-I_2$ in the t_2 and t_1 zones can be represented by the equations: $4Pr_2Se_3 + 12I_2 \rightleftharpoons [8PrI_3 + 6Se_2] \rightleftharpoons 6PrSe_2 + 2PrI + 11I_2$. (tr-auth)

25060 EQUILIBRIUM REACTIONS OF LANTHANUM AND PRASEODYMIUM CHLORIDES WITH OXYGEN. Drobot, D. V.; Korshunov, B. G.; Durinina, L. V. (Inst. of Fine Chemical Technology, Moscow). Izv. Akad. Nauk SSSR, Neorg. Mater., 1: 2189-96(Dec. 1965). (In Russian).

Using the circulation method, the equilibrium interactions of anhydrous solid chlorides of La and Pr with oxygen were investigated in the temperature intervals from 1013 to 1123 and 907 to 1035°K, respectively. The dependence of the equilibrium constant on the temperature was found. The standard heats of formation of the oxychlorides of La and Pr and some thermodynamic effects characterizing the reaction were calculated. X-ray phase analyses were made of the reaction products and it was found that the corresponding oxychlorides appear as products of the interaction of the chlorides of La and Pr with oxygen. The systems formed by chlorides and oxychlorides of La and Pr were studied. An x-ray phase analysis was made of the system RCl_3-ROCl (R = La and Pr). Electron absorption spectra showed the absence of the formation of new compounds in the $PrCl_3-PrOCl$ system. (tr-auth)

25061 THERMAL AND X-RAY STUDIES OF RARE-EARTH AND YTTRIUM CRYSTAL HYDROXIDES. Klevtsov, P. V.; Sheina, L. P. (Inst. of Inorganic Chemistry, Academy of Sciences, USSR). Izv. Akad. Nauk SSSR, Neorg. Mater., 1: 2219-26(Dec. 1965). (In Russian).

The behavior of crystalline rare earth hydroxides during thermal decomposition was studied by thermographic and x-ray methods. Thermal decomposition produced lanthanum monohydroxide and showed that LaOOH is isostructural with the previously investigated YOOH. (tr-auth)

25062 DIFFUSION OF RADIOTRACER SODIUM BY THE RESIDUAL SURFACE COUNTING TECHNIQUE IN SODA–ALUMINA–SILICA GLASSES. Garfinkel, Harmon M.; Rauscher, Herbert E. (Corning Glass Works, N. Y.). J. Appl. Phys., 37: 2169-74(Apr. 1966).

Proportional counting (beta rays) with considerable self-absorption and scintillation counting (gamma rays) with negligible self-absorption effects were found to yield essentially the same results in the two electrode glasses studied. It was found experimentally that the self-absorption of the beta radiation could be represented by a Beer–Lambert type law. For a glass of composition $27Na_2O \cdot 3Al_2O_3 \cdot 70SiO_2$ the results are best represented by $D_{Na} = 2.96 \times 10^{-4} \exp[(-13.7 \pm 0.4 \text{ kcal/g·ion})/RT]$ $cm^2\ sec^{-1}$ over the temperature range 228°–436°C, and for $11Na_2O \cdot 18Al_2O_3 \cdot 71SiO_2$ by $D_{Na} = 5.02 \times 10^{-4} \exp[(-14.5 \pm 0.3 \text{ kcal/g·ion})RT]$ $cm^2\ sec^{-1}$ over the temperature range 352°–716°C. Comparison of these results with those reported by Eisenman for the hydrated glass shows that the effect of water is to speed up the diffusion process. (auth)

25063 PROTON TRANSFER FROM H_3^+ TO UNSATURATED HYDROCARBONS AND TO CYCLOPROPANE. Aquilanti, V.; Volpi, G. G. (Univ., Rome). J. Chem. Phys., 44: 3574-80(May 1, 1966).

The ion-molecule reactions which H_3^+ and D_3^+ ions undergo with acetylene, methylacetylene, ethylene, propylene, and cyclopropane were investigated by high-pressure mass spectrometry, and the rate constants were measured. In all cases, proton (or deuteron) transfer from H_3^+ (or D_3^+) to the hydrocarbons occurs, and leads to the formation of excited ions which may either be stabilized by collision or decompose in smaller fragments when energy requirements are satisfied. Several kinetic parameters are assessed. Reactivity data for some ions with hydrogen, deuterium, and and hydrocarbons are also reported. (auth)

25064 SOLID-SOLID INTERACTIONS. IV. THORIUM NITRATE-UREA COMPLEXES. Gentile, P. S.; Campisi, L. S.; Carfagno, P. (Fordham Univ., New York). J. Inorg. Nucl. Chem., 28: 1143-8(May 1966). (TID-22040).

Using the technique of solid–solid interaction and from solution the following series of complexes were obtained: $[Th(NO_3)_4(Urea)_2(H_2O)_2]$, $[Th(NO_3)_4(Urea)_3(H_2O)_1]$, $[Th(Urea)_6(H_2O)_2](NO_3)_4$, $[Th(NO_3)_2(Urea)_6](NO_3)_2$, $[Th(NO_3)_4(Urea)_2(H_2O)_1]$, and $[Th(Urea)_8](NO_3)_4$. In all cases urea exhibited oxygen-to-thorium bonding. A reasonable argument for octacoordination could be made for all of the complexes except $[Th(NO_3)_4(Urea)_2(H_2O)_1]$. Deleterious effects on the infrared spectra were noted. They resulted from KBr-complex interactions in the solid state in KBr pellets. (auth)

25065 PREPARATION, CHARACTERIZATION AND THERMAL DECOMPOSITION OF PRASEODYMIUM, TERBIUM AND NEODYMIUM CARBONATES. Sastry, R. L. N. (Indian Inst. of Science, Bangalore); Yoganarasimhan, S. R.; Mehrotra, P. N.; Rao, C. N. R. J. Inorg. Nucl. Chem., 28: 1165-77(May 1966).

The preparation of three different types of carbonates of praseodymium, neodymium, and terbium is described. The carbonates were characterized by potentiometry, chemical analysis, x-ray crystallography, infrared spectroscopy, and by their thermal behavior. The thermal decomposition of several carbonates was studied exhaustively under a variety of conditions and the stoichiometry, thermodynamics, and energetics of the reactions at various stages of decomposition were examined. The stoichiometry of the oxides obtained as final products of decomposition was examined. (auth)

25066 PARTIAL PHASE DIAGRAM OF THE $PuCl_3$–PuOCl SYSTEM. Reavis, J. G.; Leary, J. A. (Los Alamos Scientific Lab., New Mex.). J. Inorg. Nucl. Chem., 28: 1205-8(May 1966). (LA-DC-7335).

Phase equilibria in the system $PuCl_3-PuOCl$ were studied over the temperature range from 100 to 1300°C and composition range from 0 to 35 mole % PuOCl by thermal analysis and differential thermal analysis techniques, supplemented by x-ray powder diffraction analysis. A single eutectic was found at 747°C and 8 mole % PuOCl. No evi-

dence of compound or solid solution formation was observed. (auth)

25067 CO-ORDINATION COMPOUNDS OF OXYCATIONS THORIUM(IV) AND MOLYBDENUM(V) WITH 2,2'-BIPYRIDINE-1,1'-DIOXIDE. Madan, S. K.; Donohue, A. M. (State Univ. of New York, Binghamton. Harpur Coll., Binghamton, N. Y.). J. Inorg. Nucl. Chem., 28: 1303-11 (May 1966).

Coordination compounds with 2,2'-bipyridine-1,1'-dioxide(bipyO_2) having the composition $[ZrO(bipyO_2)_3](ClO_4)_2 \cdot 2H_2O$, $[Th(bipyO_2)_4](ClO_4)_4$, $[VO(bipyO_2)_2](ClO_4)_2$, $[UO_2(bipyO_2)_2](ClO_4)_2$, $[Mo_2O_4Cl_2(bipyO_2)_2] \cdot 2H_2O$, and $[Mo_2O_3Cl_4(bipyO_2)_2] \cdot 2H_2O$ were synthesized. The compounds were characterized by infrared spectra, electronic absorption spectra, magnetic moments, and electric conductance. Infrared spectra indicated that M ← L bond (M = oxycation or metal ion, L = Ligand) in these complexes appears between the region 355 cm^{-1} to 430 cm^{-1}. (auth)

25068 THE REACTION OF TRIPHENYLPHOSPHINE WITH URANYL SALTS, AND THE PREPARATION AND INFRA-RED SPECTRA OF PHOSPHINE AND ARSINE OXIDE COMPLEXES. Hart, F. A.; Newbery, J. E. (Queen Mary Coll., London). J. Inorg. Nucl. Chem., 28: 1334-6(May 1966).

Uranyl nitrate was treated with excess triphenylphosphine in boiling cyclohexanol and the compound $UO_2(NO_3)_2(OPPh_3)_2$ in 30% yield was isolated. A similar experiment in which thorium nitrate was boiled with triphenylphosphine in cyclohexanol gave no triphenylphosphine oxide either alone or complexed. When uranyl chloride was treated with excess triphenylphosphine in boiling n-butanol, $UO_2Cl_2(OPPh_3)_2$ was obtained in very low (2%) yield in air and no product was isolated under a nitrogen atmosphere. The $UO_2(NCS)_2(OPPh_3)_2$ complex was obtained by action of potassium thiocyanate on uranyl nitrate in ethanol, followed by addition of triphenylphosphine oxide to the filtered solution. The $UO_2X_2(OAsPn_3)_2$ (X = NO_3, NCS, or Cl) complex was obtained in a similar manner. Infrared spectra were obtained. (M.C.G.)

25069 INFRARED SPECTRA OF HCl AND DCl IN SOLID RARE GASES. I. MONOMERS. Keyser, L. F.; Robinson, G. W. (California Inst. of Tech., Pasadena). J. Chem. Phys., 44: 3225-39(May 1, 1966).

A low-temperature infrared cell capable of maintaining temperatures between 7 and 50°K is used for the study of the vibration-rotation spectra of HCl and DCl in solid rare gases. Spectra at 0.2% to 2% concentrations in solid krypton and xenon are obtained. Spectra in argon have already been reported by other workers. Fine structure in the region of the (1 − 0) vibrational transitions is assigned to monomeric and polymeric species of HCl and DCl. The polymer lines can be assigned to dimers and trimers. A detailed description of these interesting features will appear in Paper II of this series. The monomer lines are assigned to vibration-rotation transitions of HCl and DCl. In addition to a J-independent band-origin shift, the rotational levels of HCl exhibit J-dependent perturbations of 5 to 10 cm^{-1}; the J-dependent perturbations of the DCl rotational levels lie between 1 and 3 cm^{-1}. Neither hindered rotation nor libration of HCl and DCl in the rare-gas crystals provides a suitable description of these perturbations. A model suggested by Friedmann and Kimel based on the interaction of the rotational motion with the localized lattice vibrational ("translational") motion of HCl and DCl at substitutional sites in the rare-gas crystals is used to interpret the J-dependent perturbations. A Hamiltonian, which treats the "translational" frequencies of HCl and DCl and the strength of the translation-rotation interaction as parameters, is constructed. The Hamiltonian matrix is truncated at a convenient size, and the perturbed energy levels are found by direct diagonalization of the truncated matrix. For a heteronuclear diatomic rotor in a cubic lattice, the translational-rotational states are shown to form a basis for the irreducible representations of a group isomorphous with D_{2h}. This property allows considerable factorization of the Hamiltonian matrix. The values of the "translational" frequencies which give the best fit to the observed rotational spacings are 36 cm^{-1} in xenon, 57 cm^{-1} in krypton, and 31 cm^{-1} in argon. The model in the case of argon is likely to be fuzzy because of the near mass resonance between argon and HCl or DCl. The strength of the translation-rotation interaction as measured by the distance between the center of mass and the center of electrical symmetry in the molecule is 0.13 Å for HCl and 0.096 Å for DCl. A mechanism for the induction of a Q branch in the vibration-rotation spectra of monomeric HCl and DCl in the solid rare gases is discussed in Paper III of this series. (auth)

25070 KINETICS OF THE REACTION D + H_2 = HD + H. Ridley, B. A.; Schulz, W. R.; Le Roy, D. J. (Univ. of Toronto, Ont.). J. Chem. Phys., 44: 3344-7(May 1, 1966).

The reaction D + H_2 = HD + H was studied in the gas phase in the temperature range 274 to 468°K. By attributing the curvature in the Arrhenius plot to quantum-mechanical tunneling and interpreting the results in terms of absolute reaction rate theory the rate constant was given by the expression $k_3 = 3.63 \times 10^{15} T^{-\frac{1}{2}} \Gamma \exp(-9.4_0 \times 10^3/RT)$. The results obtained previously for the reaction H + p-H_2 = o-H_2 + H fitted the equation $k_1 = 1.18 \times 10^{15} T^{-\frac{1}{2}} \Gamma \exp(-9.2_1 \times 10^3/RT)$. The tunneling factors Γ were calculated on the assumption of a truncated parabolic barrier and gave almost identical values for the force constant of the asymmetric stretching vibration of the complex. The results are compared with recent theoretical calculations. (auth)

25071 INFRARED SPECTRA OF HCl, DCl, HBr, AND DBr IN SOLID RARE-GAS MATRICES. Mann, D. E. (National Bureau of Standards, Washington, D. C.); Acquista, N.; White, David. J. Chem Phys., 44: 3453-67(May 1, 1966).

The infrared absorption spectra of HCl, ^{35}HCl, DCl, HBr, and DBr isolated in solid rare-gas matrices in the range 4−20°K are presented. The influence of temperature, dilution, deposition rate variations, as well as the presence of certain impurities, on the spectra are also reported and discussed. In the fundamental region the spectra normally consist of a few relatively narrow bands or lines which show reproducible and fully reversible variation of intensity and bandwidth with change of temperature. The presence of certain dopants, e.g., N_2, in the halide−noble-gas mixture leads, under suitable deposition conditions, to the replacement of the temperature-dependent features by much narrower temperature-insensitive lines at somewhat shifted frequencies. The temperature-dependent features were identified as individual rotation-vibration lines of the matrix-isolated diatomic molecules. Their separations are significantly less than those of the corresponding lines in the free molecule spectra, thereby indicating the existence of hindered molecular rotation in the matrix. The barrier to rotation is interpreted in terms of two different models for the molecule-lattice interactions and their limitations discussed. The temperature-insensitive lines show no rotational structure, and are normally obtained when N_2 or certain other dopants are present in the gas mixtures from which the matrices are formed at 20°K. They do not appear if the deposition is carried out at 4°K. It is suggested that the rotational quenching may be attributed to the formation of loose couples between halide and N_2 molecules during the condensation process. (auth)

25072 KINETIC ISOTOPE EFFECTS IN THE REACTION BETWEEN ATOMIC CHLORINE AND MOLECULAR HYDROGEN. TUNNEL COEFFICIENTS OF THE HYDROGEN ATOM THROUGH AN ASYMMETRIC POTENTIAL BARRIER. Persky, Avigdor; Klein, Fritz S. (Weizmann Inst. of Science, Rehovoth, Israel). J. Chem. Phys., 44: 3617-26(May 1, 1966).

Kinetic isotope effects for the reactions between atomic chlorine and molecular hydrogen were measured in the range of −30° to +70°C. The following expressions were obtained: $R_{H2/HT} = (1.27 \pm 0.03) \exp[(797 \pm 14)/RT]$, $R_{H2/D2} = (1.44 \pm 0.06) \exp[(1128 \pm 17)/RT]$, $R_{H2/DT} = 1.53_4 \exp$

(1422/RT), and $R_{H2/T2} = 1.54_5 \exp(1693/RT)$. The isotope effect of HD, $R_{H2/HD} = (1.24 \pm 0.03) \exp[(490 \pm 6)/RT]$, was redetermined and found to agree with previous measurements. Theoretical calculations of these isotope effects, using (1) a Sato model, (2) a generalized Sato model, and (3) the Johnston-Parr method, were made to compare the calculated effects with experimental results. Tunnel corrections were applied using (1) an asymmetric Eckart barrier, or (2) the Johnston-Rapp method with an asymmetric barrier. Best agreement (within 15%) of calculated values with experiment was obtained for a generalized Sato model including Johnston-Rapp tunnel corrections. Empirical sets of four force constants describing the transition state H−H−Cl are also given. These are used to calculate isotope effects which are in excellent agreement with experimental values. (auth)

25073 ADSORPTION OF RADIOISOTOPES ON ALUMINUM ALLOY PA-2, ANODIZED PA-2, AND STAINLESS STEEL. Proszynska, Krystyna (Instytut Badan Jadrowych, Warsaw). Nukleonika, 10: 727-32(1965). (In Polish).

The dependence of the adsorption of ^{144}Ce, ^{51}Cr, ^{65}Zn, ^{60}Co, ^{137}Cs, ^{35}S, ^{95}Zr (^{95}Nb), and ^{106}Ru (^{106}Rh) on the pH of the solution was investigated. Stainless steel (Polish Standard 1H18N9T type), PA-2 type aluminum alloy, and anodized PA-2 were chosen for the study because they are used as construction materials in reactors. The adsorption was measured by using solutions of the isotopes, determining the activity before and after interaction with the metal surface, and tabulating the effect of pH of the unbuffered solutions. (TTT)

25074 INFLUENCE OF GASEOUS MEDIA ON THE CHEMICAL REACTIONS AND POLYMORPHOUS TRANSFORMATION IN THE ZIRCONIUM DIOXIDE–CERIUM OXIDE SYSTEM. Leonov, A. I.; Keler, E. K.; Andreeva, A. B. (Grebenshchikov Inst. of Chemistry of Silicates, Academy of Sciences, USSR). Ogneupory, No. 3, 42-8 (1966). (In Russian).

The effects of oxygen partial pressures on the valence changes of cerium in the zirconium dioxide−cerium oxide system and on the refractory physical chemical properties in this system were investigated. Cerium dioxide, occurring in solid solutions in zirconium dioxide, was transformed into the trivalent state at increased temperatures in reducing atmospheres (hydrogen, carbon dioxide and ammonia), in a current of inert gases (Ar and Ne), in the atmosphere of flame furnaces with low oxygen partial pressures ($p_{O_2} = 1.4 \times 10^{-5}$ atm at 1400°C), and in vacuum (10^{-3} to 10^{-4} mm Hg). Tetravalent cerium (r = 0.88 Å) has a greater effective stabilizing effect on zirconium dioxide than trivalent cerium (r = 1.02 Å). Cyclic oxidation-reduction of cerium-containing zirconium refractories led to disintegration of the material because of the general changes accompanying the oxidation-reduction processes. (tr-auth)

25075 ALKOXIDES OF LANTHANIDE ELEMENTS: ALKOXIDES OF LANTHANUM, PRASEODYMIUM, AND NEODYMIUM. Misra, S. N.; Misra, T. N.; Mehrotra, R. C. (Univ. of Rajasthan, Jaipur, India). pp 15-19 of Proceedings of the Nuclear and Radiation Chemistry Symposium, 1964. Trombay, India, Atomic Energy Establishment, 1965.

The sodium alkoxide method was found to be conveniently applicable in the preparation of isopropoxides of lanthanum, praseodymium, and neodymium. These isopropoxides are readily soluble in hydrocarbon solvents. The method, on being extended to the preparation of cerium(III) isoproxide, could not yield favorable results and there appeared to be a ready conversion of tervalent cerium into tetravalent state. In case of lanthanum and neodymium, tri-isopropoxides were obtained, while in praseodymium, praseodymium tri-isopropoxide mono-isopropanolate could be isolated. This could be explained on the basis of the tendency of praseodymium to exhibit tetra-covalency. The isopropoxides thus prepared were used as starting materials for the synthesis of a large number of higher alkoxides and other organic derivatives using the alcohol replacement technique in the presence of benzene, which permits continuous azeotropic removal of the isopropanol produced. The molecular weight determinations of these alkoxides in boiling benzene showed them to be monomeric in nature. The alkoxides were found to be nonvolatile substances. (auth)

25076 ACYLATES OF LANTHANIDE ELEMENTS: HIGHER AND LOWER ACYLATES OF LANTHANUM, CERIUM(III), PRASEODYMIUM AND NEODYMIUM. Misra, S. N.; Misra, T. N.; Mehrotra, R. C. (Univ. of Rajasthan, Jaipur, India). pp 20-5 of Proceedings of the Nuclear and Radiation Chemistry Symposium, 1964. Trombay, India, Atomic Energy Establishment, 1965.

The synthesis and properties of aluminum acylates were previously studied and these studies were extended to similar derivatives of some lighter lanthanons. The corresponding trisoaps were precipitated by the treatment of an aqueous solution of chlorides or nitrates of lanthanum, cerium(III), praseodymium, and neodymium with an excess of sodium soaps (laurate, palmitate, stearate). These are nonhydrolyzable salts, insoluble in water but soluble in boiling benzene from which pure samples may be crystallized. Attempts to isolate mixed chloride or nitrate salts by this method were not successful. The reactions of anhydrous chlorides of these elements were studied with acetic acid and acetic anhydride. In all these reactions, triacetates of the metals are obtained in quantitative yields. Reactions of anhydrous lanthanum and cerium(III) chlorides with palmitic acid were also investigated in benzene by taking the reactants in different molar ratios and the mono-, di-, and tripalmitates were isolated. The molecular weights of all the triacylates determined ebullioscopically in benzene, showed them to be monomeric. Viscosities of the benzene solutions of higher fatty acid derivatives of lanthanum and cerium(III) were measured and their thermogravimetric behavior was also investigated. (auth)

25077 CHEMISTRY OF THE COMPLEXES OF DMSO WITH THORIUM(IV), URANIUM(IV) AND PLUTONIUM(IV) USING INFRARED AND VISIBLE SPECTRA AND MAGNETIC SUSCEPTIBILITY MEASUREMENTS. Balakrishnan, P. V.; Patil, S. K.; Sharma, H. D.; Venkatasetty, H. V. (Atomic Energy Establishment, Trombay, India). pp 30-6 of Proceedings of the Nuclear and Radiation Chemistry Symposium, 1964. Trombay, India, Atomic Energy Establishment, 1965.

Complexes of uranium, thorium, and plutonium with dimethyl sulfoxide (DMSO) were prepared and their properties studied. Magnetic susceptibility measurements on $Th(NO_3)_4 \cdot 6DMSO$ showed that the compound is diamagnetic and on $UCl_4 \cdot 3DMSO$ that the compound is paramagnetic. The magnetic susceptibility studies on $PuCl_4 \cdot 3DMSO$ in the solid phase at different field strengths showed the absence of any ferromagnetic impurity. By using the frequency shift of the S−O bond of DMSO as a criterion for the strength of metal-ligand bond in these complexes, the relative order of stability is Pu(IV) > U(IV) > Th(IV). (M.C.G.)

25078 CARBOXYLATES OF TETRAVALENT URANIUM AND THEIR CHEMISTRY. Paul, Ram Chand; Singh, Mohan; Bains, M. S. (Panjab Univ., Chandigarh, India). pp 36-40 of Proceedings of the Nuclear and Radiation Chemistry Symposium, 1964. Trombay, India, Atomic Energy Establishment, 1965.

A method using zinc amalgam and glacial acetic acid was developed for preparing uranium(IV) acetate. Uranyl chloride was refluxed in this reducing medium till reduction was complete and on cooling acetic anhydride was added and uranium (IV) acetate precipitated. Zinc hexacetato uranium(IV) was precipitated when uranyl acetate was used instead. Uranium(IV) acetate was recovered from the complex acetate by adding calculated amounts of anhydrous hydrochloric acid. Starting from uranium(IV) acetate, propionate, isobutyrate, isovalerate, caproate, benzoate, monochloroacetate, dichloroacetate, and trichloroacetate were prepared by the acid interchange method. Alkyl car-

boxylates of uranium(IV) were hydrolyzed by moist air but the rest were stable in air and hydrolyzed only slowly in water. Thermogravimetric analyses of some of these compounds, and uranium(IV) oxalate hexahydrate, uranium nitrate, hexahydrate and uranyl acetate dihydrate showed that pyrolysis of these compounds to U_3O_8 is complete at 550°C, which suggested that the temperature required to attain constant weight should be about 600°C and not that recommended in the literature (750 to 800°C). Using uranium(IV) acetate, $UCl_2(OAc)_2$, $UBr_2(OAc)_2$, $(C_5H_6N)_2UCl_6$ and $(C_5H_6N)_2UBr_6$ were prepared. When formic acid was employed instead of glacial acetic acid, uranyl chloride yielded zinc octaformato uranium(IV), $Zn_2U(OOCH)_8$ in high yield. (auth)

25079 SOME OBSERVATIONS ON HYDRATED URANIUM TETRAFLUORIDE AND DIMETHYL AMMONIUM ACETATE SYSTEM. Saraswat, I. P.; Mishra, S. B.; Tripathi, K. K. (Roorkee Univ., India). pp 41-4 of Proceedings of the Nuclear and Radiation Chemistry Symposium, 1964. Trombay, India, Atomic Energy Establishment, 1965.

Ion migration studies on a solution prepared by heating uranium tetrafluoride and dimethyl ammonium acetate under reduced pressure indicated that uranium(IV) predominantly exists as highly associated cationic species. From infrared absorption spectrum studies of this system, it appeared that the lattice water from $UF_4 \cdot nH_2O$ is completely removed by this process, as no absorption band was observed in the region 3550 to 3200 cm^{-1} (antisymmetric and symmetric O–H stretching modes). From the variation in solubility of hydrated uranium tetrafluoride in diethyl ammonium acetate at different pH values, obtained by varying the ratios of glacial acetic acid and diethylamine, a possible mechanism of dissolution was developed. (auth)

25080 TTA EXTRACTION METHOD FOR DETERMINATION OF STABILITY CONSTANTS. Patil, S. K.; Sharma, H. D. (Atomic Energy Establishment, Trombay, India). pp 45-50 of Proceedings of the Nuclear and Radiation Chemistry Symposium, 1964. Trombay, India, Atomic Energy Establishment, 1965.

The values of stability constants show variation when determined by TTA and ion exchange methods. It was observed that these variations were significant for many actinide ions. In order to explain the discrepancy, the TTA system in various media was examined by determining its distribution in the aqueous and organic phases having perchlorate for maintaining constant ionic strength and varying the composition of chloride, sulfate, bromide, and nitrate. It was found that in the case of chloride, sulfate, and bromide systems when u = 1 and pH = 3, the solubility of TTA in the aqueous phase decreases linearly with increasing ligand concentration whereas in the case of the thiocyanate system it increases linearly. In the case of nitrate system, however, the solubility of TTA remains practically constant. These effects were incorporated in the equilibria for evaluating stability constants. (auth)

25081 ELECTRO DEPOSITION OF HEAVY ELEMENTS ^{227}Ac AND ^{237}Np. Jain, H. C.; Iyer, R. H.; Namboodiri, M. N.; Rajagopalan, M. (Atomic Energy Establishment, Trombay, India). pp 51-6 of Proceedings of the Nuclear and Radiation Chemistry Symposium, 1964. Trombay, India, Atomic Energy Establishment, 1965.

Conditions for the electrodeposition of ^{227}Ac and ^{237}Np were studied. It was found that ^{237}Np gave quantitative and adherent deposits of up to 150 ug/cm^2 at pH 2 from ammonium formate-perchloric acid media at a current density of about 50 ma/cm^2; with larger amounts, the deposition was not quantitative. ^{228}Ac was used as a tracer in the electrodeposition study of ^{227}Ac. Conditions for the quantitative deposition are pH 2 from nitric acid media and a current density 200 ma/cm^2. Sources of ^{227}Ac were prepared for fission studies. (auth)

25082 TRACER STUDIES OF DIFFUSION AND SELF DIFFUSION OF ^{131}I AND ^{60}Co IN AGAR-AGAR GEL. Shukla, B. M.; Singh, V. N. (Banaras Hindu Univ., India). pp 144-8 of Proceedings of the Nuclear and Radiation Chemistry Symposium, 1964. Trombay, India, Atomic Energy Establishment, 1965.

Systematic investigations of ^{131}I and ^{60}Co were carried out in agar-agar gel between 0 to 50°C and at different molar concentrations. A 0.2 cm zone of the diffusing electrolyte labeled with the suitable radioactive isotope, was allowed to set in the middle of the diffusion column containing the pure gel. The tube, corked at both ends, was placed horizontally in a thermostat and maintained at the desired temperature for 24 hr. After this, the tube was taken out and the diffusion column on either side of the central zone and at known lengths was sliced into a series of 0.5-cm long samples. These were transferred to Al foil planchets, weighed, and dehydrated in a hot-air oven. Subsequently, activity for each such sample was measured by means of a well-shielded end-window G-M counter under conditions of constant geometry. Studies of self-diffusion of ^{131}I and ^{60}Co, at different temperatures and molar concentrations, and of tracer diffusion of Cs containing 0.01M sodium nitrate at 25°C were also made. Calculations of diffusion coefficients were made in each case and the overall results plotted graphically. The results are explained theoretically. (auth)

25083 STUDY OF ELECTRO-DIFFUSION OF CADMIUM IONS BY TRACER TECHNIQUE. Shukla, B. M.; Gupta, R. P. (Banaras Hindu Univ., Varanasi, India). pp 149-53 of Proceedings of the Nuclear and Radiation Chemistry Symposium, 1964. Trombay, India, Atomic Energy Establishment, 1965.

Electrodiffusion and electromigration of ^{115m}Cd were investigated in aqueous agar-agar medium containing different molar concentrations of the electrolytes cadmium chloride and cadmium nitrate at different potential gradients. A 0.2-cm zone of diffusing electrolyte labeled with ^{115m}Cd was allowed to set in a fixed position between the two diffusion columns at a particular distance from one end of the tube. To keep the temperature of the system constant, this tube was jacketed with another wider tube and water circulated. The two ends of the tube were attached to two other wider tubes containing platinum electrodes, connected to an a-c power supply. A constant flow of electrolytic solution of the same concentration as in the gel, was maintained through these end tubes. At different intervals the tube was taken out and a series of samples of 0.5-cm length from either side of the zone were cut, weighed, dehydrated, and their activity measured. In case of electromigration under a d-c field, a slightly different experimental procedure was adopted. The values of diffusion coefficients in and against field direction were calculated. The limits of the applicability of known equations and a possible explanation of the asymmetric effect are discussed. (auth)

25084 ELECTRODIFFUSION OF LABELLED IONS IN AGAR GEL AND FUSED MEDIA. Arnikar, H. J.; Tripathi, R. (Univ. of Poona, India). pp 154-9 of Proceedings of the Nuclear and Radiation Chemistry Symposium, 1964. Trombay, India, Atomic Energy Establishment, 1965.

Tracer and self-diffusion of labeled ions under an electric field (d-c) were used to study relaxation times for ions in two different states in a column in terms of different "average lives." Unequal time lags were assumed for an ion of a given sign in occupying holes available in and against field direction. (auth)

25085 TRACER DIFFUSION OF ALKALINE EARTH METAL IONS IN FUSED MEDIA. Arnikar, H. J.; Pansare, R. M. (Univ. of Poona, India). pp 160-5 of Proceedings of the Nuclear and Radiation Chemistry Symposium, 1964. Trombay, India, Atomic Energy Establishment, 1965.

Tracer diffusion of alkaline earth metal ions (i.e., $^{45}Ca^{2+}$, $^{90}Sr^{2+}$, and $^{131}Ba^{2+}$) was studied in molten $NaNO_3$, KNO_3, and their eutectic mixture ($NaNO_3 + KNO_3$) at a constant temperature of 350 ± 2°C. A narrow zone of the radioactive ion is deposited at the center of a calcined and impregnated

asbestos strip, which is then placed in a horizontal position in a tubular furnace electronically maintained at constant temperature. After a period of 24 hr the strip is cut into a series of samples 5-mm in length and the radioactivity is determined in each by a thin mica end-window G-M counter under conditions of constant geometry. A plot of radioactivity versus distance from the origin results in a Gaussian distribution. The required function appropriate to the boundary conditions of zone diffusion is provided by the integral of Fick's II law. The coefficient of tracer diffusion was calculated. Results provided significant information about the mechanism of transport of bivalent ions with respect to ionic parameters and associated solvent effects. (auth)

25086 APPLICABILITY OF MODELS TO PREDICT RATES OF CATION MOVEMENT IN CLAYS. Gast, R. G. (Univ. of Tennessee, Oak Ridge). Contract AT-40-1-GEN-242. Soil Sci. Soc. Amer., Proc., 30: 48-52(Jan.-Feb. 1966).

Results of electrical conductance and diffusion measurements in dilute bentonite pastes show significant changes in Na^+ and Sr^{2+} ion mobility on increasing solution or clay concentration. Any useful model to predict rates of cation movement in those systems must allow for these changes in mobility. A three-component model does provide for these changes and appears promising to predict rates of cation movement in systems where the geometry is not affected by varying the electrolyte levels or the nature of the cation species. The use of two-component models to predict rates of cation movement in such systems requires the capability to predict the mobility of exchangeable cations (those cations on the clay) by some independent measurement or fundamental property of the system. Exchangeable cation mobility did not vary in Na- and Sr-kaolinite systems with increasing electrolyte levels. Two-component models could be used to predict rates of cation movement in these systems provided the geometry factor and mobility of exchangeable cations is known. (auth)

25087 THERMAL REDUCTION OF SAMARIUM OXIDE BY LANTHANUM. Gvelesiani, G. G.; Bagdavadze, E. I. (Georgian Inst. of Metallurgy, USSR). Soobshch. Akad. Nauk Gruz. SSR, 41: 657-64(Mar. 1966). (In Russian).

The dependence of the equilibrium pressure of samarium vapor and of the isobar-isotherm potential on the temperature during lanthanum thermal reduction of Sm_2O_3 obeys the equations $\lg P_{MM} = 8.21 - 11250/T$(1225 to 1473°K) and $\Delta Z^0_T = 102940 - 48.77T$(1225 to 1473°K). The optimum conditions for investigation of the process are: Mol ratio, $La/Sm_2O_3 = 2.75$; temperature, 1200°C; length of the reaction, 1 hr; pressure of the briquetting charge, 2500 kg/cm^2, size of the Sm_2O_3 and lanthanum powder, $-1 + 0.5$ mm; and vacuum, $\sim 10^{-3}$ mmHg. During the lanthanum thermal reduction of Sm_2O_3 the interstitial alloy $Sm_x - La_y$ was formed. The reaction velocity at the beginning of the process was limited by evaporation of the samarium from the interstitial alloy and at the end by diffusion of reagent across the solid reaction product La_2O_3. The total reduction reaction is described by the equation $Sm_2O_{3(s)} + 2La_{(l)} \rightarrow 2Sm_2 + La_2O_{3(s)}$. (auth)

25088 MOESSBAUER EFFECT AND CHEMICAL BONDING IN TRANSITION METAL COMPLEXES. Danon, J. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). pp 89-110 of STI-DOC-10/50.

The relations between the hyperfine interactions of the Mössbauer effect and the bonding in complexes of transition-metal ions are discussed in detail. The information that can be obtained using the Mössbauer effect is compared with the information that can be obtained by other methods. (D.C.W.)

25089 APPLICATION OF MOESSBAUER SPECTROSCOPY TO CHEMISTRY OF IRON AND TO BIOCHEMICAL PROBLEMS. Fluck, E. (Univ., Heidelberg). pp 134-41 of STI-DOC-10/50.

The isomeric shift and the quadrupole splitting in iron compounds are discussed. The information that can be obtained by observation of these quantities is stressed. Some applications of the Mössbauer effect to biochemical problems are also discussed. (D.C.W.)

25090 STRUCTURES OF THE URANYL 8-HYDROXYQUINOLATES. Magee, Robert J.; Woodward, Ida (Queen's Univ., Belfast). Talanta, 13: 709-14(May 1966).

An x-ray investigation of the two uranyl 8-hydroxyquinolates, $UO_2 \cdot (C_9H_6NO)_2 \cdot C_9H_6NOH$ (dark red) and $[UO_2 \cdot (C_9H_6NO)_2]_2 \cdot C_9H_6NOH$ (orange), was carried out on untreated compounds and after recrystallizing them from chloroform. The unsolvated compound $UO_2 \cdot (C_9H_6NO)_2$ and the residue remaining after dissolving the orange compound in chloroform were also examined. The investigation showed that the crystals obtained from the red and orange compounds, respectively, after dissolving them in chloroform and recrystallizing, are identical. The untreated red and orange compounds were different, the latter showing evidence of existing as a polymer, whereas the former was crystalline. On the basis of the results obtained, a structure for the orange compound is proposed. (auth)

25091 MASS SPECTROMETRIC DETERMINATION OF THE STABILITY OF GASEOUS MOLYBDITES, TUNGSTITES, MOLYBDATES AND TUNGSTATES OF MAGNESIUM, CALCIUM, STRONTIUM AND TIN. Verhaegen, G.; Colin, R.; Exsteen, G.; Drowart, J. (Universite Libre, Brussels). Trans. Faraday Soc., 61: 1372-5(July 1965).

Various gaseous oxides were identified by mass spectrometry during vaporization of MgO, CaO, SrO, and SnO_2 + Sn from Mo and W crucibles. The stabilities of the gaseous molecules $SrMoO_3$, $SrWO_3$, $CaWO_3$, $MgMoO_4$, $CaMoO_4$, $SrMoO_4$, $MgWO_4$, $CaWO_4$, $SrWO_4$, $SnWO_4$, and Sn_2WO_5, were deduced from the measurements. The tabulated data include the ions identified and their appearance potentials, dissociation energies (D^0), and atomization energies. The free-energy functions of the gaseous molybdates, tungstates, molybdites, and tungstites were calculated from the usual statistical mechanical formulas. The electronic partition functions of the gaseous molybdates and tungstates were assumed to be the same as for MoO_3 and WO_3 and those of the gaseous molybdites and tungstites equal to those of MoO_2 and WO_2. The values calculated were: for $SnWO_4$, 88 (1100°K), 90 (1200°K), 92 (1300°K); for Sn_2WO_5, 120 (1200°K); for $MgMoO_4$, $MgWO_3$, $CaWO_4$, $SrMoO_3$, $SrWO_3$, and $SrWO_4$, 105 (2000°K), 107 (2100°K), 108 (2200°K), 109 (2300°K), 110 (2400°K); and for $CaMoO_4$ and $SrMoO_4$, 108 (2000°K), 109 (2100°K), 110 (2200°K), 112 (2300°K), 113 (2400°K) cal/mole deg. The auxiliary thermodynamic data used are $D^0_0(O_2) = 117.96$; $D^0_0(MgO) = 85.5$; $D^0_0(CaO) = 92.5$; $D^0_0(SrO) = 102.2$; $D^0_0(SnO) = 126.5$; $D^0_0(SnO - SnO) = 66.1$; D^0_0 at $(MoO_2) = 261.5$; D^0_0 at $(WO_2) = 295.7$; D^0_0 at $(MoO_3) = 411.1$; D^0_0 at $(WO_3) = 443.0$; ΔH^0_0, sub(Sn) = 72.0; ΔH^0_0 sub(Mo) = 157.1; and ΔH^0_0 sub(W) = 199.7 kcal/mole. The different oxides identified showed a surprising stability. This is possibly due to important ionic contributions in the intramolecular forces. (BBB)

25092 INFRA-RED SPECTROSCOPIC STUDIES OF AQUEOUS SYSTEMS. PART I. MOLAR EXTINCTION COEFFICIENTS OF WATER, DEUTERIUM OXIDE, DEUTERIUM HYDROGEN OXIDE, AQUEOUS SODIUM CHLORIDE AND CARBON DISULPHIDE. Thompson, W. K. (Unilever Research Lab., Port Sunlight, Eng.). Trans. Faraday Soc., 61: 2635-40(Dec. 1965).

A technique is described for preparing thin cells of known thickness in the range 0.4–1.7 μ. The cells can be used to record the infrared absorption spectra of liquids and solutions which possess very strong absorption bands. The molar extinction coefficients were determined for some fundamental infrared absorption bands of water, deuterium oxide, deuterium hydrogen oxide, aqueous sodium chloride solution and carbon disulfide. (auth)

25093 INVESTIGATIONS OF THE SYSTEM N_2H_4–$UO_2(NO_3)_2$–H_2O. [PART] I. Brcic, B. S.; Komac, M.; Kolar, D.; Slivnik, J. (Nuclear Inst. Jozef Stefan, Ljubljana,

Yugoslovakia). Vestn. Sloven. Kem. Drustva, 11: 15-17 (1964). (In Slovenian).

On addition of hydrazine hydrate to a dilute aqueous solution of uranyl nitrate up to weak alkaline reaction, the uranium in +6 valence state was precipitated. A large excess of hydrazine hydrate up to strong alkaline reaction reduced the uranium to +4 valence state, which was precipitated as uranium dioxide hydrate. (auth)

25094 MEASUREMENT OF THE HEAT OF SOLUTION AND CALCULATION OF THE HEAT OF FORMATION OF URANYL HYDRONITRATES IN WATER AND IN ALCOHOL. Feng, Shih-yen; Li, Hsiang-yun (Northwestern Univ., Sian, China). Yuan Tzu Neng, No. 3, 233-8(1965).

The experimental value for the heat of solution of 1 g molecule of potassium chloride in 200 gram molecules of water at 25°C was found to be consistent with the value reported in 1949, i.e. 4194 ± 3 cal/g molecule. In comparison, the heat of solution of 1 g molecule of hexahydro, trihydro, and dihydro uranyl nitrate in 200 g molecules of water at 25°C was found to be 5494, −1692, and −5317 cal/g molecule, respectively. The heat of formation calculated for hexahydro, trihydro, and dihydro uranyl nitrate was −759.4, −547.1, and −475.1 kilocalories/g molecule, respectively. Based on the experimental results for uranyl nitrate hexahydrate in alcohol, the heat of solution in straight-chain alcohols increased with an increase in the number of carbon atoms. The heat of solution of the hexahydrate also increased in the order isopropyl, isobutyl, and isoamyl alcohol, and with a constant number of carbon atoms, the heat of solution of the hexahydrate in straight-chain alcohols was lower than that in branched chain alcohols. (ATD)

25095 CRYSTAL STRUCTURE OF LANTHANUM TRIFLUORIDE. Mansmann, M. (Univ., Munich). Z. Kristallog., 122: 375-98(Dec. 1965). (In German).

The LaF_3 structure was previously described in the space group $P6_3/mmc$ with two formula units per unit cell. Weak additional reflections on single-crystal photographs led to a larger unit cell with a = 7.190 ± 0.002 Å, c = 7.367 ± 0.002 Å, space group $P\bar{3}c1$, and six LaF_3 per unit cell. The structure was refined by full-matrix least-squares computations. Deviation from the high symmetry was caused by displacements of the F ions. LaF_3 is shown to be isotypic with HoD_3. The calculated ionic-lattice energy (−1151.6 kcal/mole) agreed with the energy calculated by a Born-Haber cycle (−1144.4 kcal/mole). The probable critical radius ratio for the change from the LaF_3 to the orthorhombic YF_3 structure is 0.94. For smaller ratios the LaF_3 structure can be stabilized by anion vacancies. (auth)

25096 CRYSTAL STRUCTURE OF YB_4. Giese, R. F. Jr.; Matkovich, V. I.; Economy, J. (Carborundum Co., Niagara Falls, N. Y.). Z. Kristallog., 122: 423-32 (Dec. 1965).

A structure determination of YB_4 was carried out in order to determine the boron positions in metal tetraborides. The structure proposed by earlier workers based on ThB_4 was confirmed; however, departures in the occupancy of some boron positions were found. As a consequence, each octahedral boron group is, on the average, one atom short. This argues against the structure interpretation proposed earlier, which was based on a continuous framework of boron atoms. A crystal-chemical interpretation of the tetraboride structure is presented in terms of tetrahedral units, which demonstrates a structural framework common to MB_4, M_3B_2, and M_2B type compounds. (auth)

25097 LUMINESCENCE SPECTRUM AND POLARIZATION OF CRYSTALLINE SODIUM URANYL ACETATE. Volod'ko, L. V.; Komyak, A. I.; Sleptsov, L. E. Zh. Prikl. Spektrosk., 3: No. 2, 134-41(1965). (In Russian).

The luminescence spectrum of sodium uranyl acetate single crystals at 77°K was studied. The crystals were grown from an aqueous solution of the salt by free evaporation at room temperature. Specimens with well developed natural faces were selected for the experiments. It was found that slow cooling of the crystals to −196°C caused no additional imperfections in the structure (cracks, erosion of the surface layer, etc.), which would produce any noticeable changes in the spectrum or polarization of the lines. A DFS-12 double diffraction monochromator with a linear dispersion of 5.2 Å/mm was used for studying the luminescence spectra. The spectra were recorded on a continuously recording potentiometer. The luminescence in the specimen was excited by emission with a wavelength of 365 mμ from a mercury lamp, passed through a filter and a blue vitriol solution. The luminescence spectrum is divided into six bands with an average distance of 850 cm^{-1} between homologous lines in neighboring bands. The principal lines (21131, 20278, 19426, 18575, 17726, and 16886 cm^{-1}) are circularly polarized. The degree of polarization is considerably less than 1 (21, 25, 29, 33, 39, and 37%, respectively), and increases noticeably toward the red end of the spectrum. The remaining lines of the spectrum are unpolarized. The intensity distribution, frequencies, and polarization of the lines are independent of whether the light of various wavelengths that excites the luminescence is linearly or circularly polarized. A DMR-4 double quartz monochromator and a DKSSh-1000 xenon lamp were used for excitation of luminescence at various wavelengths. All lines observed at 77°K are attributed to internal vibrations of the complex $UO_2(CH_3COO)_3^-$ ion. It was assumed that the lines could not be due to external vibrations of the crystal lattice, since these should have considerably lower frequencies because of the large masses of the vibrating groups and the relatively small forces of interaction between molecules. It is suggested that the luminescence activity of these crystals is due to complex uranyl triacetate ions, which belong to the point group of C_3 symmetry. (ATD)

25098 KINETIKA OKISLITEL'NO VOSSTANOVITEL'NYKH REAKTSII URANA NEPTUNIYA PLUTONIYA V VODNOM RASTVORE. (Kinetics of Reduction-Oxidation Reactions of Uranium, Neptunium, and Plutonium in Aqueous Solutions). Koltunov, V. S. Moscow, Atomizdat, 1965. 320p.

A survey of original works, published through 1964, on the kinetics of oxidation-reduction reactions of U, Np, and Pu is given. Reactions of these elements with ions of Fe, V, Ti, Ce, Tl, and Sn, and with hydrogen, hydrogen peroxide, hydrazine, nitrous and nitric acids, chlorine, hypochlorous and chlorous acids, iodides, and ammonium persulfate are described. Reactions between similar ions of U, Pu, and Np, including disproportionation and recombination reactions, are considered. Data are presented on the order of magnitude of the reactions, reaction rates, activation energies, and effects of catalysts, inhibitors, and ionic strength on the reaction rates. Thermodynamic values of activation are also given. The most probable mechanisms of the reactions are evaluated. (M.J.T.)

25099 IONIC SELF-DIFFUSION COEFFICIENTS OF SODIUM AND CESIUM IN AGAR GELS AS FUNCTIONS OF CONCENTRATIONS AND TEMPERATURE [Thesis]. Slade, Arthur Laird. Raleigh, N. C., Univ. of North Carolina, 1964. 121p.

A method using γ-emitting radioisotopes for the measurement of ionic self-diffusion coefficients in gels is described. A solution of the diffusion equation for the appropriate boundary conditions is given. The problem of matching this solution to experimental data by the method of least squares is solved in a form suitable for mechanical computation and was programmed for a UNIVAC 1105 computer. A description of the program is included. The self-diffusion coefficients for Na^+ in 0.0010 M., 0.0100 M., and 0.0500 M. NaCl at 1.0, 2.0, 3.0, and 4.0 weight per cent agar gel were measured. Measurements were also made for Cs^+ in 0.0010 M. and 0.0500 M. CsCl in 1.0, 2.5, and 4.0 weight per cent agar and at 0.5 weight per cent agar in 0.0500 M. CsCl. All measurements were carried out at both 10 and 25°C. A linear dependence of the self-diffusion coefficient on the agar gel content was found. An expression relating D and the agar content of the gel is suggested. The experimental results are least

squared to this expression and the values of D(0), the self-diffusion coefficient for zero agar gel content, are calculated. The values of D(0) calculated in this study are in complete agreement with the values of D(0) calculated from the limiting ionic conductances. Values of $\Delta H^{\ddagger}$ are calculated from the Eyring formulation. Values of $\lambda e^{\Delta S^{\ddagger}/2R}$ are also calculated. It is concluded that the agar gel acts only to block the diffusing species. The value of D at zero gel content is taken as the value of the self-diffusion coefficient for the same salt concentration in aqueous solution. (Dissert. Abstr.)

25100 SPECTRA SYMPOSIUM, SESSION S-1 AND SPECTRA, SESSION S-2. BOOK ONE [OF PREPRINTS OF] FIFTH RARE EARTH RESEARCH CONFERENCE, AUGUST 30-SEPTEMBER 1, 1965. 164p. (CONF-650804(Bk.1). ORAU.

Thirteen papers and abstracts of two papers, presented at the Spectra Symposium and Spectra Session of the Fifth Rare Earth Research Conference are collected. Separate abstracts were prepared for 7 of the papers. Five of the papers were previously abstracted for NSA. For abstract numbers of individual papers see CONF 650804 in the Report Number Index. (M.C.G.)

For abstracts of individual papers see: 25009, and 25101–25106.

25101 OPTICAL SPECTROSCOPY OF RARE EARTH COMPOUNDS. Hellwege, K. H. pp 15-26 of Spectra Symposium, Session S-1 and Spectra, Session S-2. Book One [of Preprints of] Fifth Rare Earth Research Conference, Aug. 30-Sept. 1, 1965.

The term schemes of Nd^{3+} and Tb^{3+} ions were investigated up to 40,000 cm^{-1}; the absorption spectrum of the $^2F_{5/2} \rightarrow {}^2F_{7/2}$ transition in anhydrous $CeCl_3$ was analyzed. An extensive study of magnetically ordered compounds was undertaken ($GdCl_3$, DyAlG, ErIG, DyIG, HoIG); the internal fields for these compounds were obtained in the ordered state. In La(Er)Cl_3 an example for the correlation of linewidth of fluorescence lines and the ORBACH coefficient is given. (auth)

25102 ON THE ENHANCEMENT OF THE FLUORESCENCE OF AQUEOUS SOLUTIONS OF NEODYMIUM, SAMARIUM AND DYSPROSIUM CHLORIDES. Heller, Adam (General Telephone and Electronics Labs. Inc., Bayside, New York). pp 77-85 of Spectra Symposium, Session S-1 and Spectra, Session S-2. Book One [of Preprints of] Fifth Rare Earth Research Conference, Aug. 30-Sept. 1, 1965.

Substitution of H_2O by D_2O enhances the fluorescence of aqueous solutions of the chlorides of trivalent neodymium, samarium, and dysprosium. The fluorescence of the two latter weakly absorbing ions is further intensified by energy transfer from water-soluble organic compounds in their triplet state. The minimum deuteration enhancement factors are four for neodymium, fourteen for samarium, and one hundred for dysprosium. The sensitizing triplets enhance the fluorescence of samarium and dysprosium by an order of magnitude. The emission spectra of the H_2O, D_2O, sensitized, or unsensitized solutions of any of the ions were identical. The dominant emission lines were 10,550 Å for neodymium, 5947 Å for samarium, and 4795 Å for dysprosium. (auth)

25103 LOW-TEMPERATURE OPTICAL STUDIES OF RARE-EARTH CYCLOPENTADIENIDES. Pappalardo, R. (Cyanamid European Research Inst., Geneva). pp 87-98 of Spectra Symposium, Session S-1 and Spectra, Session S-2. Book One [of Preprints of] Fifth Rare Earth Research Conference, Aug. 30-Sept. 1, 1965.

The optical properties of rare earth cyclopentadienides were studied. These compounds, where the rare earth ion is bound to a five-membered aromatic ring, are very sensitive to air. Most rare earth tricyclopentadienides were studied at 78°K, both as sublimed films and in organic solutions. The spectrum of $Ndcp_3$ was studied in detail at liquid helium temperatures. Many of the undiluted rare earth cyclopentadienides showed fluorescence associated with the aromatic ligand and broad absorption bands at rather low energies. Complex chemistry was shown by ytterbium in its reactions with cyclopentadiene. The composition of the sublimed phases is discussed on the basis of their infrared and optical spectra. (auth)

25104 SOME NEW ELECTRON-TRANSFER SPECTRA OF TRIVALENT LANTHANIDES. Barnes, John C.; Pincott, Hugh (Queen's Coll., Dundee, Scotland). pp 111-21 of Spectra Symposium, Session S-1 and Spectra, Session S-2. Book One [of Preprints of] Fifth Rare Earth Research Conference, Aug. 30-Sept. 1, 1965.

Electron transfer spectra are presented for the compounds $LnPO_4$, $Ln_2(CO_3)_3$, Ln_2(oxalate)$_3 \cdot 10\ H_2O$, and several compounds containing sulfate or halide ions. Ln = Sm, Eu, and Yb. The consequences of change in coordination number and structure are discussed. Oxyanions had very similar optical electronegativities, which did not correlate with their oxidation potentials. (auth)

25105 OPTICAL AND PHYSICAL PROPERTIES OF SINGLE-CRYSTAL LANTHANUM TRIFLUORIDE. Muir, Hugh M.; Stein, William (Varian Associates, Palo Alto, Calif.). pp 123-36 of Spectra Symposium, Session S-1 and Spectra, Session S-2. Book One [of Preprints of] Fifth Rare Earth Research Conference, Aug. 30-Sept. 1, 1965.

Optical and physical measurements on high-purity single-crystal LaF_3 indicated its potential as a valuable optical window material. It gives excellent transmission over a very broad spectrum extending from ~1300 Å in the vacuum ultraviolet to ~13 μ in the intermediate infrared and has a high degree of chemical and physical stability. Some of the critical purification and crystal growth conditions necessary for synthesis of high-purity, optical grade LaF_3, as well as the optical and physical parameters, are presented. (auth)

25106 SPECTRAL CHARACTERISTICS OF Nd^{3+} AND Er^{3+} TRIETHYLENETETRAMINEHEXAACETIC ACID COMPLEXES. Boudreaux, E. A.; Mukherji, A. K. (Louisiana State Univ., New Orleans). pp 139-50 of Spectra Symposium, Session S-1 and Spectra, Session S-2. Book One [of Preprints of] Fifth Rare Earth Research Conference, Aug. 30-Sept. 1, 1965.

A series of stable rare earth chelates with triethylenetetraminehexaacetic acid (TTHA) were prepared in aqueous solution. Those of Nd^{3+} and Er^{3+} showed intensification of the $^4G_{5/2}$ and $^4G_{11/2}$ absorption bands. The rare earth ion–TTHA stoichiometry is 1:1. On making assumptions about the complex having a common nine-fold coordination of D_{3h} symmetry, rationalization of these observations in terms of a weak covalent bonding interaction did not seem reasonable. The mechanism of pseudo-quadrupole interaction at the rare earth ion may offer a plausible explanation. (auth)

25107 METHOD OF REMOVING HYDROGEN FROM LIQUID ALKALI METALS. Bohlmann, E. G.; Compere, E. L. (to U. S. Atomic Energy Commission). U. S. Patent 3,243,280. Mar. 29, 1966.

The activity of hydrogen in a system containing liquid NaK was reduced by adding from 0.1 to 5 wt % lithium to the NaK. (AEC)

25108 PREPARATION OF ACTINIDE MONOCARBIDE. Petkus, Edward J.; Tevebaugh, Arthur D. (to U. S. Atomic Energy Commission). U. S. Patent 3,250,590. May 10, 1966.

A process for preparing actinide monocarbide is described. Finely divided actinide metal is converted into a fluidized condition at between 600 and 700°C by introducing a gaseous hydrogen-hydrocarbon mixture as the fluidization and reaction gas, and restricting the hydrogen content of the gas mixture to between 70 and 87% by volume. (AEC)

Organic Chemistry

25109 (ORNL-TM-1510) SYNTHESIS OF 2,6-DIOXIMINOCYCLOHEXANONE. Holsopple, H. L. (Oak

Ridge National Lab., Tenn.). Apr. 28, 1966. Contract W-7405-eng-26. 5p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Essentially pure 2,6-dioximinocyclohexanone was prepared for the Nuclear-Radiochemical Group of the Analytical Chemistry Division. This chemical, part of a new type of coordination compound useful in extraction studies, was synthesized by the reaction of methyl nitrite with cyclohexanone in an acid ethereal solution. Elemental analysis was in good agreement with calculated values. (auth)

25110 (UCRL-14714) PREPARATION AND PROPERTIES OF 2,4-DINITROPHENYL FLUOROALKYL ETHERS. Bissell, Eugene R.; Schaffer, Sheldon A. (Lawrence Radiation Lab., Univ. of California, Livermore). Feb. 25, 1966. Contract W-7405-eng-48. 8p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

2,4-Dinitrophenyl ethers of trifluoroethanol, 2,2,3,3-tetrafluoropropanol, heptafluorobutanol, 1,1,5-trihydroperfluoropentan-1-ol, 1,1,7-trihydroperfluoroheptan-1-ol, 2,2-difluoro-2-nitroethanol, and 3,3,3-trifluoropropan-2-ol were synthesized by the reaction of 1-chloro- or 1-fluoro-2,4-dinitrobenzene with the corresponding alcohol in the presence of a base. The effects of the nature of the base, reaction temperature, time of reaction, and reactant ratios on the yield of the 1,1,5-trihydroperfluoropentyl ether were studied. (auth)

25111 SYNTHESIS OF TRITIUM-LABELED ORNITHINE AND ARGININE OF HIGH SPECIFIC ACTIVITY. **Birkofer, Leonhard; Hempel, Klaus; Nouvertne, Werner (Univ., Cologne). Chem. Ber., 98: 3200-3(1965). (In German).**

Labeled ornithine was prepared by catalytic hydrogenation of α-acetamino-β-(2-chloroacetaminoethyl)acrylic acid with ^3H. A solution of 37.4 mg of this compound and 40 mg $NaHCO_3$ in 1.5 ml ethanol was hydrogenated with 96% $^3H_2$ over Pd/C. After absorption of 0.8 cc gas, the remainder was pumped off and the reduction continued with inactive H_2 for an hour. The catalyst was filtered off, washed with 10 ml water, and the filtrate heated with 100 ml 6N HCl for 6 hr. The HCl was removed in vacuum and the product taken up in 20 ml water, clarified with charcoal, and deposited on addition of 480 ml 80% ethanol at −15°C. It contained 950 mC DL-ornithine-α,β-$^3H_2$ (radiochemical yield 47%; total yield 60% by ninhydrin, sp. act. 9300 mC/mmol). Another kind of labeling was achieved by reducing 22.2 mg 3-nitropyridone-2 in 1.5 ml acetic acid at 20°C at normal pressure with 5 mg PtO_2 with inactive H_2 (12 ml), then replacing H_2 with pure $^3H_2$ until 2.1 cc were taken up. After workup as before, DL-ornithine-$\alpha,\beta,\gamma,\delta$-$^3H_4$ was obtained (15 mC, 0.3% radiochemical yield, 91% yield). Arginine was prepared by treatment of the Cu complex of ornithine with O-methylisourea and was purified by paper chromatography. (BBB)

25112 POLYTOPE LABELING OF MESCALINE AND 2,3,4-TRIMETHYOXY-β-PHENETHYLAMINE WITH TRITIUM. Seiler, N.; Werner, G.; Schmidt, K.-H. (Max-Planck-Institut fuer Kernforschung, Frankfurt am Main). J. Label. Compounds, 1: 306-7(Oct.-Dec. 1965). (In German).

The Yavorsky and Gorin exchange reaction was used for tritium labeling of mescaline and 2,3,4-trimethyoxy-β-phenethylamine. In the case of mescaline a yield of 41.2% with an activity of 68 mC/mM was obtained and for 2,3,4-trimethyoxy-β-phenethylamine a yield of 52% with an activity of 2 mC/mM was obtained. (J.S.R.)

25113 DEUTERIOXIDE-CATALYZED EXCHANGE REACTIONS OF METHYLENECYCLOPROPANECARBOXYLIC ACIDS WITH DEUTERIUM OXIDE. **Bottini, Albert T.; Davidson, Alan J. (Univ. of California, Davis). J. Org. Chem., 30: 3302-8(Oct. 1965).**

To determine the extent to which α-hydrogen exchange is accelerated by the exocyclic double bond, the rates of D_2O catalyzed exchange of D_2O with 2-methylenecyclopropane-1-carboxylic acid (I), 3-methylenecyclopropane-cis-1,2-dicarboxylic acid (II), 3-methylenecyclopropane-trans-1,2-dicarboxylic acid (III), and the corresponding carboxylic acids, cyclopropanecarboxylic acid (IV), cyclopropane-cis-1,2-dicarboxylic acid (V), and cyclopropane-trans-1,2-dicarboxylic acid (VI), were measured by NMR spectroscopy. Rates of D_2O-catalyzed racemization of I and III were also determined. At 152°C, the extrapolated rate constant for exchange of I was $>10^4$ greater than that for IV. The rate of racemization of I was equal to its rate of exchange, indicating that the postulated carbanion intermediate is either planar or exists long enough for inversion at carbanionic carbon to occur several times before it abstracts a deuteron from the solvent. The exchange reaction of II appeared to involve a carbanion intermediate, which was converted to II and III at equal rates. Over the temperature range studied, the estimated rate constant for exchange of one α-hydrogen of the unsaturated cis-diacid II was ~100 times greater than the corresponding rate constant for the unsaturated trans-diacid III. At 152°C, the extrapolated rate constants for II and III were $>10^5$ greater than those for the saturated diacids V and VI. Using the derived expressions for the exchange of III, which require the assumption that exchange occurs via a carbanion that is converted to II and III at effectively equal rates, the rate constant for exchange of one α-hydrogen was calculated to be identical with that obtained using the derived expressions for the racemization of III. (BBB)

25114 R. I. LABELED ORGANIC COMPOUNDS UNDER IRRADIATION. [PART] II. **Taki, Ko; Hishiki, Yasushi (Inst. of Physical and Chemical Research, Tokyo). Rika Gaku Kenkyusho Hokoku, 37: 106-13(1961). (In Japanese).**

The possibility of obtaining organic molecules with extremely high specific activity by recoil labeling was investigated. Organically bound ^{35}S atoms were generated at the JRR-1 pile through the reaction of thermal neutrons in the $^{35}Cl(n,p)^{35}S$ process. β-Chloronaphthalene, α-chloronaphthalene, and a mixture of naphthalene and p-dichlorobenzene used as chlorine sources were irradiated for about 40 to 70 hr at a neutron flux of about 10 n/cm^2 sec. Naphthols, nitrochlorobenzene, and p-dichlorobenzene used as chlorine source were irradiated in the same way. A mixture of naphthalene and elemental ^{35}S and a mixture of nitrobenzene and elemental ^{35}S were γ irradiated at a dose of 3.3×10^4 R/hr and total dose of 10^7 R. Several sulfur compounds were isolated by carrier techniques. These sulfur compounds were counted as barium sulfate. Thermal neutron irradiation of β-chloronaphthalene and α-chloronaphthalene resulted in the successful labeling of β-naphthylsulfide and α-naphthylsulfide compounds with ^{35}S. But neutron irradiation of naphthalene containing p-dichlorobenzene and γ irradiation of naphthalene containing elemental ^{35}S resulted in better labeling of β-naphthylsulfide than the α-sulfide compound with ^{35}S. From the γ irradiation of nitrobenzene containing elemental ^{35}S, the activity ratio of o- and m-dinitrodiphenyldisulfides to p-dinitrodiphenyldisulfide was about 5.7 : 2.0 : 1.0. From the neutron irradiation of o-, m-, and p-chloronitrobenzene, the activity ratios of o- and m-dinitrodiphenyldisulfides to p-dinitrodiphenyldisulfide were about (56.6 : 12.7 : 1.0), (12.9 : 8.1 : 1.0), and (18.1 : 3.4 : 1.0), respectively. The results of the neutron irradiation of o-, m-, and p-chloronitrobenzene and γ irradiation of nitrobenzene containing elemental ^{35}S showed that the o-sulfide compound is obtained in a better yield than m- and p-compounds. (BBB)

25115 SOME PROCEDURAL PROBLEMS OF THE PRODUCTION OF HIGHLY ACTIVE XANTHOPHYLL PREPARATIONS. **Saakov, V. S.; Saidov, A. S. (Komarov Botanical Inst., Academy of Sciences, USSR. Samarkand State Univ., USSR). Uzb. Biol. Zh., No. 4, 5-9(July-Aug. 1965).**

An attempt was made to produce ^{14}C-labeled violaxanthin and lutein, with a specific activity per microgram no less than three to four times as great as the background of the counter (20 counts/min). Sprouts of higher plants, kept in Knop's nutrient solution (pH 5.5), and leaf cuttings on moist

filter paper were exposed to an atmosphere with $^{14}CO_2$ in light in a hermetic chamber. The activity of the xanthophylls isolated from sprouts was higher than in the pigments isolated from leaf cuttings. Illumination and temperature also substantially influenced the intensity of synthesis of highly active carotenoid preparations. The probability of obtaining the greatest activity of the preparation, with all other conditions equal, increased with duration of exposure to $^{14}CO_2$. The specific activities of the violaxanthin and lutein preparations were rather close, indicating a genetic relation of these two pigments. The preparations of labeled xanthophylls obtained from leaves of higher plants in biosynthesis in an atmosphere of radioactive carbon dioxide with high specific activity are suitable for preparative purposes. Attempts to produce ^{14}C-labeled xanthophylls from Chlorella by exposure to glucose-^{14}C led to preparations with low specific activity in comparison with the background. This low activity of xanthophyll preparations is attributed to the low specific activity (approximately two millicuries per gram) of the original glucose-1-6-^{14}C preparation. (ATD)

25116 PREPARATION OF RADIOSULFUR-LABELED CARBON DISULFIDE AND SULFUR TRICHLORIDE. Yao, Chieh-hsing; Feng, Su-chuan. Yuan Tzu Neng, No. 3, 258-60(1965).

$C^{35}S_2$ is an important intermediate in the synthesis of ^{35}S-labeled compounds. An efficient method for the preparation of $C^{35}S_2$ is described involving the use of elemental ^{35}S to exchange for the S in CS_2 in the presence of C_2H_5-$C\overset{\rightleftharpoons S}{\underset{SK}{}}$ and C_2H_5OH. These materials were sealed in a specially designed container, which was heated to 100°C in a waterbath for three hours. After this period of time, the exchange between ^{35}S and S reached equilibrium. The chemical yield of $C^{35}S_2$ by this method was 94.4%, and the yield in radioactivity was calculated to be 88.6%. The $C^{35}S_2$ thus obtained was then reacted with chlorine gas for the production of $^{35}S_2Cl_3$, which is an intermediate in the synthesis of medicinal chemicals. An apparatus for the reaction and collection of $^{35}S_2Cl_3$ is described. The yield was 55% and the radioactive recovery was 55.5%. The sulfur content of this product was 19.90%, which was somewhat higher than the theoretical value (17.25%). This discrepancy was determined to be the result of the formation of SCl and other sulfur–chloride compounds as by-products. (ATD)

25117 HANDBOOK OF FLUORESCENCE SPECTRA OF AROMATIC MOLECULES. Berlman, Isadore B. Contract W-31-109-eng-38. New York, Academic Press, 1965. 258p. $8.50.

Spectra of approximately 100 aromatic molecules, varying in size, shape, and structure, are assembled. The list of molecules begins with the simple aromatic molecule benzene and includes progressively larger and more complicated systems. The luminescence characteristics of each aromatic molecule were measured in a systematic fashion. Fluorescence and absorption spectra are plotted for each molecule and additional data related to the fluorescence process are given in each graph. Additional data include the fluorescence decay time, fluorescence quantum yield, natural lifetime as computed from the absorption spectrum, Stokes loss, wavelength of the center of gravity of the fluorescence spectrum, and the average wavelength of the fluorescence spectrum. Supplementary material such as topical bibliographies, tables to convert wavelength to wave number and energy, values of the index of refraction of cyclohexane as a function of wave number, and values of oscillator strengths are appended. (P.C.H.)

Radiation Chemistry

See also BIOLOGY AND MEDICINE — Radiation Effects on Biochemicals Radiation Effects on Tissues

25118 (AD-632461) THE RADIOLYTIC DECOMPOSITION OF HYDRAZINE, RP-1, AND HYDYNE ROCKET FUELS. Shelberg, W. E. (Naval Radiological Defense Lab., San Francisco, Calif.). Mar. 6, 1966. 21p. (USNRDL-TR-1002). CFSTI $1.00 cy, $0.50 mn.

One-hundred-milliliter samples of the storable liquid rocket fuels hydrazine, RP-1, and Hydyne generated, respectively, 89.1, 50.3 and 149.4 ml of radiolytic off-gas (measured at 25°C and 1 atm) when irradiated to 8.5×10^6 rads with gamma rays. When approximately 5 wt % of an efficient, olefinic, free-radical scavenger was added to the samples, the off-gas volume produced by RP-1 fuel was reduced by 18.7% while those of hydrazine and Hydyne fuels were not reduced. These scavenging effects show that RP-1 fuel decomposes radiolytically by both free-radical (18.7%) and molecular mechanisms, and that hydrazine and Hydyne fuels decompose entirely by a molecular or ionic mechanism. (auth)

25119 (AERE-R-5181) A COMPARISON OF GAS PHASE REACTION CALCULATIONS CARRIED OUT ON THE RADIATION-INDUCED REACTION BETWEEN CARBON DIOXIDE AND GRAPHITE. Tait, J. H. (Atomic Energy Research Establishment, Harwell (England)). Mar. 1966. 14p. Dep. BIS $0.50. HMSO 2s. 6d.

The theoretical work of Jones (G.E.C. Rpt. No. 14, 160c, 1962) on the diffusion of species produced by the irradiation of carbon dioxide and their attack on graphite was compared with the treatment given in AERE-R.5087 (1965). The former dealt with the attack on the outer surface of the graphite while the latter was concerned mainly with the in-pore attack. The two treatments are basically the same, starting with the one velocity group diffusion equation. It is shown that it is just possible to account for the observed inhibition of the in-pore attack by the addition of a few per cent of carbon monoxide to the carbon dioxide on an oxygen atom mechanism. (auth)

25120 (BNL-954, pp 114-21) HOT LABORATORY DIVISION. Stang, L. G. Jr. (Brookhaven National Lab., Upton, N. Y.).

Research progress is reported on Te chemistry, Tc chemistry, triton reactions, Pd complexes, solvent extraction synergism, solvent properties of dimethyl sulfone, electrochemistry of U, isotope production, and radiography service. (J.R.D.)

25121 (CU-2791-5) THE EFFECTS OF RADIATION ON THE CHEMICAL ACTIVITY OF CERTAIN SOLID OXIDE CATALYSTS. Progress Report, April 1–December 31, 1965. (Columbia Univ., New York. Radiation Chemistry Research Group). Contract AT(30-1)-2791. 21p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Studies of hydrogen-deuterium exchange on alumina showed that radiation definitely enhanced the activity of this catalyst. The effects of radiation decreased with increasing temperature with a negative activation energy of 5 to 7 kcal/mole. Measurement of the activation energy for removal of sites, made by following the rate of decay in activity after irradiation was stopped, gave a value between 3 and 6 kcal/mole. A reasonable explanation for these results is that radiation forms trapped electrons or holes, upon which the exchange reaction takes place with little, if any, activation energy. Release of these trapped electrons or holes may have an activation energy of around 6 kcal/mole. The results demonstrated the value of in situ measurements because the life-time of the active sites was too short at 50 to 150° to be analyzed solely by post-irradiation measurements. Contrary to previous results, additional tests on zinc oxide showed no effects from irradiation. (P.C.H.)

25122 (HW-SA-3440) RADIOLYSIS OF MIXTURES OF CARBON MONOXIDE AND WATER VAPOR. Tingey, G. L. (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). Apr. 6, 1964. Contract AT(45-1)-1350. 13p. (CONF-526-2; CONF-606-7). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From Libby/Cockcroft US/UK Meeting on Graphite Chemistry, Richland, Wash., May 1964.

From American Chemical Society Northwest Regional Meeting, Spokane, Wash., June 1964.

Studies were made on the effects of gamma radiation on mixtures of CO and water vapor as a function of temperature, total dose, concentration of reactants, and pressure. The products of the reaction were found to be H, CO_2, and small quantities of CH_4 and CH_3OH. (P.C.H.)

25123 (INR-672/XVII/C) EPR STUDY OF THE KINETICS OF RADICAL FORMATION AND DISAPPEARANCE IN GAMMA RADIOLYSIS OF TETRAHYDRONAPHTHALENE. Kecki, Zbigniew; Kosek, Stanislaw (Institute of Nuclear Research, Warsaw (Poland)). Dec. 1965. 16p. Dep.

The kinetics of radical reactions in gamma irradiated frozen tetrahydronaphthalene was studied. The kinetic equations were derived and the experimental results obtained are discussed. (auth)

25124 (NYO-3383-3) STUDIES IN CHEMICAL RADIATION PROTECTION AGENTS. Progress Report. Trumbore, Conrad N. (Delaware Univ., Newark. Dept. of Chemistry). Apr. 18, 1966. Contract AT(30-1)-3383. 11p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Studies were continued on the aqueous radiation chemistry of cysteine which acts as a protective agent against ionizing radiation. It was found that cysteine reacts on almost every collision with every known reactive intermediate in radiolyzed water solutions. Thus the complete scavenging ability of this compound for free radicals now has been demonstrated in quantitative fashion for the first time. In continuing studies of the mechanism of reaction of cysteine with irradiated water a new phenomenon was obtained which implies a precursor for the H and OH radicals in acid and possibly in neutral solution. A hypothesis now being tested is that excited water molecules are quenched by cysteine at very low concentrations, with the resulting production of free radicals, which in turn may be scavenged by cysteine. Other studies are exploratory in nature and involve the study of radioresistant algae and some compounds that help to test the above hypothesis. (auth)

25125 (RRL-2310-174) QUARTERLY REPORT [ON RADIATION RESEARCH], JANUARY 1, 1966–MARCH 31, 1966. Fundamental Research No. 6041. (Radiation Research Labs., Mellon Inst., Pittsburgh, Pa.). Apr. 15, 1966. Contract AT(30-1)-2310. 11p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Developments are reported for studies on: vibrationally excited cyclopropane; photochemistry of 1,3-dioxolane; ESR spectra of fluorinated ethyl radicals; ESR spectra and structure of SF^+ and PF_4; ion recombination in propane radiolysis; mercury photosensitized decomposition of hydrocarbons; tetravalent iron in pulse irradiated ferric perchlorate solutions; and radiation chemical studies with heavy ions. (P.C.H.)

25126 (AECL-2330, pp 1-13) RADIATION STABILITY OF TECHNICAL MONO-ISOPROPYLDIPHENYL AT DIFFERENT TEMPERATURES. Aleksenko, Yu. N.; Khramchenkov, V. A. Translated from pp 5-15 of Issledovaniya po Primeneniyu Organicheskikh Teplonositelei-Zamedlitelei v Energeticheskikh Reaktorakh, Atomizdat, Moscow, 1964.

The buildup of high-boiling products of radiolysis in technical monoisopropylbiphenyl at different temperatures was investigated, as well as the effect of heat treating irradiated monoisopropylbiphenyl on this process. The monoisopropylbiphenyl specimen contained 15% biphenyl and about 5% heavier products, chiefly diisopropylbiphenyl. The dosage rate was approximately 30–40 Mrad/hr and the heat treatment temperature range was 350–380°C. Low temperature radiolysis was carried at 2 to 3 gauge atmospheres of technical nitrogen and high-temperature radiolysis was carried out at 5 to 10 gauge atmospheres of technical nitrogen. It is pointed out that the process of radiation polymerization of monoisopropylbiphenyl at high temperatures has a complex character and cannot be investigated as the result of the additive pile-up of radiation and thermal effects. In addition, the composition of the high-boiling products is not constant and depends significantly on both the integral radiation dose and the temperature of radiolysis. In the case of radiolysis at 360–380°C, the thermally stable, high-boiling product is close to tetraphenyl. In the case of radiolysis at 200–300°C, the radiation-chemical yield of high-boiling products decreases. (ATD)

25127 (AECL-2330, pp 14-32) RESEARCH ON MIXTURES OF PARTIALLY HYDROGENATED TERPHENYLS AND THEIR APPLICATION AS ORGANIC COOLANT MODERATORS. Aleksenko, Yu. N.; Brodskii, A. M.; Lavrovskii, K. P.; Khramchenkov, V. A. Translated from pp 16-30 of Issledovaniya po Primeneniyu Organicheskikh Teplonositelei-Zamedlitelei v Energeticheskikh Reaktorakh, Atomizdat, Moscow, 1964.

Included are methods for preparing heat-transfer agents, the results of investigations on their behavior in the process of radiothermal conversions in ampoule tests and in a circulating reactor, as well as the changes in thermophysical and physico-chemical properties of these compounds. The incompletely hydrogenated terphenyls (HTP) were obtained by fractional crystallization of different bottoms at 400 to 420°C, from which 6% biphenyl, 8–10% orthoterphenyl, 24% metaterphenyl and 24% paraterphenyl were obtained. Investigations of the radiothermal stability of HTP were carried out in three directions: (1) investigations of the thermal stability in the absence of radiation; (2) investigations of radiation stability at different temperatures under conditions of ampoule irradiation; and (3) investigations of radiothermal stability under working conditions for a loop experiment on a reactor. These tests were conducted in stainless-steel ampoules in an atmosphere of technical nitrogen and lasted for 200 hrs. Measurements were also made of the content of the high-boiling product, kinematic viscosity of the specimen, and the molecular weight of the high-boiling product. It is shown that radiolysis of HTP at 350 to 380°C leads to the formation of gaseous, high-boiling and low-boiling products. In addition, the composition of the products forming during radiolysis at 350 to 370°C indicates flow in the latter along with the reactions of condensation, dehydrogenation and cracking. It is also pointed out that there was no formation or precipitation in the form of particles or films of any insoluble products. (ATD)

25128 (AECL-2330, pp 33-52) INVESTIGATION INTO THE POSSIBILITY OF USING THE GAS OIL FRACTION OF NATURAL OIL AS A COOLANT FOR NUCLEAR REACTORS. Brodskii, A. M.; Lavrovskii, K. P.; Zvonov, N. V. Translated from pp 31-46 of Issledovaniya po Primeneniyu Organicheskikh Teplonositelei-Zamedlitelei v Energeticheskikh Reaktorakh, Atomizdat, Moscow, 1964.

The basic results of loop investigations and investigations in ampoules of the radiothermal conversions of a gas-oil fraction are presented. The raw material was a specially prepared gas-oil from a non-sulfurous petroleum having a naphthene-aromatic base. In the experiments, both the purely thermal and radiothermal resistance of a gas-oil were investigated in stainless-steel ampoules in an atmosphere of technical nitrogen. The results of measurements obtained from the pyrolytic tests show that the gas-oil is completely stable at 200 to 250°C. At 300 to 370°C, destructive processes set in leading to the formation of low-boiling products. At 420°C, a very rapid buildup of high-boiling products is detected. It is shown that with an increase in the total radiation dose the hydrogen concentration decreases and the content of heavier hydrocarbons increases during radiolysis. Considerable attention was given to studying the chemical reactions occurring directly in liquid fractions under the influence of radiation from a nuclear reactor at a total dose of 600 Mrad. The formation of light-boiling radiolysis products was studied as a function of the buildup of fractions boiling at up to 150°C and from 150 to 200°C. A discussion of the formation of radiation-induced polymers at 300°C is presented. It is shown that the examined gas-oil fraction can be used in nuclear reactors up to 330°C. (ATD)

25129 (AECL-2330, pp 63-70) ON THE HYDROGENATIVE REGENERATION OF ORGANIC COOLANTS. Brod-

skii, A. M.; Lavrovskii, K. P.; Makarov, D. V.; Fish, Yu. L.; Zvonov, N. V. Translated from pp 56-62 of Issledovaniya po Primeneniyu Organicheskikh Teplonositelei-Zamedlitelei v Energeticheskikh Reaktorakh, Atomizdat, Moscow, 1964.

The results of model tests on the use of gas-oil and hydroterphenyl as heat-transfer agents are presented. The regeneration of the heat-transfer agents was carried out under conditions of hydrocracking on an Al–Co–Mo catalyst under a hydrogen pressure of 40 to 60 atm at a temperature of 300 to 350°C in the reactor. The changes in the content of polymers and unsaturated compounds as a function of the dose of absorbed energy were determined during radiolysis of the gas-oil fraction. It is shown that regeneration by hydrogenation enables one to maintain the prescribed amount of polymers and unsaturated compounds in the working heat-transfer agent within wide limits. It is also shown that the unsaturated compounds are completely eliminated during the process of regeneration and that the concentration of the products of radiation polymerization is greatly reduced. It is concluded that the material balance during the regeneration of hydrogenated terphenyls does not differ from the balance during regeneration of a gas-oil with respect to either hydrogen consumption or the yield of end products. (ATD)

25130 RADIATION-CHEMICAL SYNTHESIS OF PHOSPHONIUM AND ARSONIUM SALTS. Drawe, H.; Caspari, G. (Hahn-Meitner Institut fuer Kernforschung, Berlin). Angew. Chem. Int. Ed. Engl., 5: 317-18(Mar. 1966).

Gamma irradiation of mixtures of triphenylarsine or triphenyl phosphine with aryl halides gives tetraphenylarsonium or -phosphonium salts. Yields of arsonium salts are about one-tenth of those of phosphonium salts. The quantum yields are independent of the dosage and are not influenced by the oxygen content. It is shown that yields of tetraphenylphosphonium are a maximum with a molar ratio of chlorobenzene : triphenylphosphonium chloride of 96 : 4. This indicates a capture mechanism, i.e., absorption of energy by the solvent chlorobenzene and capture of the decomposition products by triphenylphosphine. (F.J.H.)

25131 DISSOCIATION OF ETHYLENE MOLECULE IONS FORMED IN CHARGE EXCHANGE COLLISIONS WITH POSITIVE IONS. Szabo, I. (Royal Inst. of Tech., Stockholm). Ark. Fys., 31: 287-98(1966).

Mass spectra of ethylenes (C_2H_4 and CH_2CD_2) were obtained after charge exchange with slow positive ions. The intensities of the peaks were plotted as a function of the energy absorbed by the molecule during the charge exchange. The structure and dissociation of ethylene are discussed. Three distinct processes for the formation of the acetylene ion are proposed. Integration of the breakdown graph gives a mass spectrum in reasonable agreement with that obtained in electron impact. (auth)

25132 INFLUENCE OF THE MOLECULAR STRUCTURE ON THE LOCALIZATION AND THE BEHAVIOR OF RADIATION-INDUCED RADICALS. Koch, R.; Langendorff, H.; Moenig, H. (Univ., Freiburg i. B.). Atomkernenergie, 11: 209-14(May-June 1966). (In German).

Electron spin resonance investigations of x-ray- and/or uv-irradiated cystein, isocysteine, S-alkylated cysteines, S-carboxymethylcysteine, methionine, homocysteine, homocysteinethiolactone, pyridoxine, and some mercapto derivatives of pyridoxine demonstrated the influence of molecular structure on the behavior of the radical localization and the final quantum yield. In order to understand the biological damage after ionizing irradiation better these circumstances are to be taken into consideration. (auth)

25133 ROLE OF METAL IONS IN THE γ RADIOLYSIS OF DRY METAL-RIBONUCLEASE COMPLEXES. Riesz, Peter (National Cancer Inst., Bethesda, Md.). Biochem. Biophys. Res. Commun., 23: 273-9(May 3, 1966).

It is suggested that metal ions may affect the initial act of energy deposition and so diminish the amount of energy absorbed by the enzyme or by its active site. An alternative explanation appeared to be that metal ions protect because of their ability to act as scavengers of electrons and/or of hydrogen atoms. To investigate this possibility, the reduction of cupric ions during the γ-radiolysis of Cu^{2+}-ribonuclease complexes was studied as a function of dose and of Cu^{2+}/ribonuclease ratio and compared with the survival of enzymatic activity. The results of experiments at room temperature and at 77°K are consistent with the second of these alternatives. (auth)

25134 THERMAL RELEASE OF ^{35}S FROM REACTOR IRRADIATED SODIUM CHLORIDE. Jech, C. (Inst. of Physical Chemistry, Prague). Collect. Czech. Chem. Commun., 31: 1385-8(Mar. 1966).

Studies were made to determine if damage diffusion is operative in release of ^{35}S tracer atoms from NaCl by reactor radiation. Sodium chloride pellets weighing 0.36 g were irradiated with $\sim 10^{17}$ cm^2 pile thermal neutrons 8 months prior to date of experiments. The delay was to allow the ^{24}Na activity to die-out, leaving only ^{35}S activity produced by the (n,p) reaction with a specific activity of 0.24 mC/g. It was observed that sulfur activity was released from the pellets on heating and that the activity could be fixed by allowing it to react with a layer of lead dioxide anodically deposited on the surface of a lead plate. The maximum release of ^{35}S occurred at ~230°C. The release of ^{35}S during linear tempering is discussed. It is shown that there are at least two kinds of processes by which ^{35}S activity is released. At temperatures up to 350°C a "damage type" rapidly proceeding release predominates, which appears to be connected with a range of activation energies. This release component declines when the lattice damage is annealed during tempering and at temperatures in excess of 400°C sulfur atoms reach the surface and are released by normal diffusion. (F.J.H.)

25135 PARAMAGNETIC CENTERS IN IRRADIATED SILVER OXALATE. Potapovich, A. K.; Sviridov, V. V.; Makatun, V. N.; Branitskii, G. A. (Inst. of Physics, Academy of Sciences, Belorussian SSR. Belorussian State Univ.). Dokl. Akad. Nauk BSSR, 10: 11-14(Jan. 1966). (In Russian).

The electron paramagnetic resonance of irradiated polycrystalline silver oxalate was examined in order to determine the effect of ionizing and ultraviolet radiations on the formation of paramagnetic centers. In order to eliminate the effect of incidental impurities, 30 samples prepared by different methods were used; the methods included mixing together aqueous solutions of silver sulfate or nitrate with oxalic acid solutions and precipitating previously formed silver oxalate from its ammoniacal solution by oxalic acid. The crystals were exposed to a mercury quartz lamp or to 72 R/sec of γ rays from a ^{60}Co source at room temperature. A radiospectrometer with a h-f modulated magnetic field was used to record the EPR spectra. No signals were obtained before irradiation but afterwards stable EPR signals were recorded up to 100°C, at which temperature the silver oxalate was thermally decomposed. Different signals were obtained at different stages of the radiolysis; differences were also noted between samples prepared by different methods. One type of signal is ascribed to paramagnetic centers creating a superfine structure from three nonequivalent Ag ions; a second one is due to the ion radical CO_2^-. Some of the signals also appeared during photolysis after exposure to ultraviolet radiation. (TTT)

25136 EFFECT OF GAMMA IRRADIATION ON THE TIME DEPENDENCE OF POLYMER STRENGTH. Narzullaev, B. N.; Karimov, S. Dokl. Akad. Nauk Tadzh. SSR, 7: No. 6, 12-16(1964).

The irradiation dose ranged from 0 to 4×10^8 R. It is shown that within these limits, in spite of the different character of the effect of the γ irradiation on the materials, the time dependence of the mechanical strength is of the form $\tau = A \exp(-\alpha\sigma)$, where σ is the static rupture stress and A and α are constants that determine the strength properties of the materials. The values of the coefficients A and α were calculated as functions of the radiation dose. (ATD)

25137 SIGNIFICANCE OF THE HYDRATED ELECTRON IN RADIATION CHEMISTRY. Hart, Edwin J. (Argonne National Lab., Ill.). Health Phys., 12: 641-51 (May 1966).

The discovery of the hydrated electron and its observation by spectroscopic methods are briefly treated. In addition some physical properties, reactions and applications of the hydrated electron are discussed. Reactions with the species of irradiated water, with inorganic ions, and with organic molecules vary from diffusion controlled rates for certain free radicals to about 10^{-9} of this rate for water. Its natural half-life in water is 780 μsec and because of the interconversion of hydrated electrons and H atoms in alkaline solution, its lifetime in alkaline solution is much longer. (auth)

25138 HYDROGEN ISOTOPE EFFECTS IN THE VAPOR-PHASE RADIOLYSIS OF WATER. Yang, John Y.; Marcus, Inge (North American Aviation Science Center, Thousand Oaks, Calif.). J. Amer. Chem. Soc., 88: 1625-9(Apr. 20, 1966).

Tritium-labeled water and 1:1 H_2O-D_2O solutions, each containing cyclopentane as an additive, were irradiated in the vapor phase by ^{60}Co γ rays. Isotopic analyses of the radiolytic hydrogen led to calculated values of $\alpha_T = 1.7 \pm 0.1$ and $\alpha_D = 1.2 \pm 0.1$ as the relative rates for H vs T and H vs D atom formations. These values were much smaller than the values of 2 to 6 reported for the deuterium isotope effect in the radiolysis of liquid water, indicating that different reaction processes are involved. (auth)

25139 COMPARISON OF RADICAL AND NONRADICAL PROCESSES IN THE CONDENSED-PHASE RADIOLYSIS OF n-HEXADECANE. Falconer, W. E.; Salovey, R. (Bell Telephone Labs., Inc., Murray Hill, N. J.). J. Chem. Phys., 44: 3151-60(May 1, 1966).

The effects of state, temperature, and chemically reactive solutes on the radiolysis of n-hexadecane in condensed phases were examined. All product yields are reduced by radical scavengers in liquid-state n-hexadecane, but only dotriacontane isomers are reduced in the solid. Iodine acts as a chemical scavenger and is more effective than 2-methylpentene-1. A hot-hydrogen-atom mechanism, together with molecular elimination, accounts for the formation of most of the hydrogen in the irradiation of n-hexadecane. Low-molecular-weight products are formed entirely by molecular reactions in the solid-state radiolysis and, about equally, via molecular and radical processes in the liquid. Intermediate-molecular-weight products in the liquid radiolysis are 80% from combinations of radicals from chain scission with various hexadecyl radicals. The remaining 20% in the liquid and the total intermediate yield in the solid are from nonradical processes. The combination of hexadecyl radicals yields at least 40% and 70% of the dotriacontane isomers in the radiolysis of pure n-hexadecane in the solid and liquid state, respectively. The remaining dimer may also be due to radicals which are formed in pairs, but ion-molecule reactions cannot be excluded. Temperature dependence of all products is small. Cage recombination of scission fragments and crosslinking of proximate radical pairs is enhanced in the solid state as compared with the liquid. Internal $\cdots CH_2-CH_2\cdots$ rupture is equally probable at all positions, and seven times as likely as terminal $CH_3-CH_2\cdots$ scission. Methyl C–H rupture is 40% as probable per bond as methylene C–H rupture. (auth)

25140 IONIZATION OF LIQUIDS BY RADIATION. I. METHODS FOR DETERMINATION OF ION MOBILITIES AND ION YIELDS AT LOW VOLTAGE. Hummel, Andries; Allen, A. O. (Brookhaven National Lab., Upton, N. Y.). J. Chem. Phys., 44: 3426-31(May 1, 1966). (BNL-9560).

Experimental methods are described in detail for determination of ion mobilities and of the zero-field conductivity induced by irradiation of insulating liquids with x rays. The yield of separated ions is thereby obtained with an accuracy of ±11% and is found to be 0.10 ion pairs per 100 ev for hexane at 23°C. The physical processes resulting from absorption of high-energy radiation are less well understood for liquids than for gases. Though it has long been thought that most ions produced in liquids disappear immediately by initial recombination, with only a small fraction of the excitation events leading to real charge separation, no actual measurement of the yield of separated charges was available when this determination was first undertaken (late in 1961). From the magnitude of this value for different liquids and its dependence on temperature an attempt is made to deduce something about the behavior of slow electrons in liquids and the geometrical distribution of the radiation-induced electric charges. (auth)

25141 IONIZATION OF LIQUIDS BY RADIATION. II. DEPENDENCE OF THE ZERO-FIELD ION YIELD ON TEMPERATURE AND DIELECTRIC CONSTANT. Hummel, Andries; Allen, A. O.; Watson, Freddie H. Jr. (Brookhaven National Lab., Upton, N. Y.). J. Chem. Phys., 44: 3431-6(May 1, 1966). (BNL-9561).

The positive- and negative-ion mobilities and the yield of separated ion pairs were determined for irradiated hexane over the temperature range 200°–300°K, and for carbon tetrachloride and 1,4-dioxane at room temperature. The effect of radiation quality on the ion yield in hexane was also studied. The ion mobilities were changed in hexane by small amounts of added foreign substances. The temperature coefficient of mobility is greater than that of the solvent viscosity for both positive and negative ions in hexane. The data do not allow any firm conclusion regarding the nature of the negative ion in pure hexane. The data on ion yields in hexane are discussed in terms of the theoretical energy-loss spectrum of the primary fast electron which is responsible for the ionization, and Onsager's expression for the escape probability on an ion pair formed near to each other in a fluid medium. The number of high-energy secondaries (above 1000 ev) is much too small to account for the observed yields of separated charge. It is concluded that electrons, generated by ionization with kinetic energies below 100 ev, travel much farther on the average from their parent ions than would be expected by extrapolation of electron ranges measured at higher energies. (auth)

25142 FORMATION OF MOLECULAR HYDROGEN PEROXIDE IN RADIOLYSIS OF AQUEOUS SOLUTIONS. Anbar, Michael (Weizmann Inst. of Science, Rehovoth, Israel); Pecht, Israel; Stein, Gabriel. J. Chem. Phys., 44: 3635-6(May 1, 1966).

The effect of $H_2^{16,16}O_2$ concentration on the radiolytic yields of $H_2^{18,18}O_2$ and $H_2^{16,18}O_2$ from $H_2^{18}O$ was investigated at pH = 5–6, at room temperature, using ^{60}Co gamma rays. The results show that the increase of $G(H_2^{16,18}O_2)$ complies with a cube-root dependence of $[H_2^{18,16}O_2]$ over the whole range, $G(H_2^{16,18}O_2)/[H_2^{16,16}O_2]^{1/3} = 0.37 \pm 0.03$. For $G(H_2^{18,18}O_2)$ the fit was found to be worse particularly at low concentration. Over a considerable range, however, $G(H_2^{18,18}O_2)/[H_2^{16,16}O_2]^{1/3}$ is 0.20 ± 0.03. An explanation is given for the results. (L.B.S.)

25143 ESR STUDY OF PRIMARY PROCESSES IN RADIATION CHEMISTRY. IONIC INTERMEDIATES FORMED IN GAMMA IRRADIATED ORGANIC SYSTEMS AT LOW TEMPERATURE. Fueki, Kenji; Kuri, Zenichiro (Nagoya Univ., Japan). J. Chem. Soc. Jap., Ind. Chem. Sect., 68: 1544-7(Aug. 1965). (In Japanese).

Trapped intermediates formed in gamma-irradiated organic systems at 77°K were investigated by an electron spin resonance technique. Special attention was given to ionic species. The irradiation of 2-methyltetrahydrofuran (MTHF) gives rise to color or spin centers destroyed by light. Two types of spin centers observed may be attributed to trapped electrons, one of which is considered to be solvated electrons. The formation of solvated electrons was suppressed in the presence of electron scavengers. Benzyl radicals were observed in MTHF containing benzyl compounds following gamma irradiation. The formation of benzyl radicals can be interpreted in terms of dissociative electron attachment. The formation of toluene anions appears to be responsible for a new spin center in a MTHF-

toluene system. A light-sensitive, unsymmetrical singlet observed in gamma-irradiated 3-methylpentane (3MP) is attributable to trapped electrons. The G-values for trapped electrons and radicals formed in this system were estimated. Toluene cations seemed to be produced in a 3MP-toluene system. In pure aromatic compounds a light-sensitive absorption line similar to that in 3MP was observed, and the G-value and the steady concentration of trapped electrons were obtained from dose-yield relations. (auth)

25144 ESR STUDY OF FREE RADICALS PRODUCED IN SOME ORGANO-SULFUR COMPOUNDS BY IRRADIATION AT −196 DEG C. Akasaka, Kazuyuki; Ohnishi, Shun-ichi (Kyoto Univ.). J. Chem. Soc. Jap., Ind. Chem. Sect., 68: 1548-52(Aug. 1965). (In Japanese).

Free radicals produced in several organo-sulfur compounds in the glassy or polycrystalline state by irradiation with a 1.5-Mev electron beam at −196°C were studied by the electron spin resonance method in the temperature range of −196°C to room temperature. In alkyl mercaptans, radicals of the R-S· type are produced when the number of carbon atoms in the alkyl chain is relatively small (about three); alkyl radicals become prominent when the alkyl chain becomes longer. In homocystine, carbon radicals are produced in contrast to cystine, with a smaller amount of R-S·. In diphenyl- and dibenzyl-disulfide, only sulfur radicals are produced. In di-n-butyl sulfide and S-benzyl-L-cysteine, whose sulfur atoms are in C−S−C, radicals of the type $-\dot{C}H-S-CH_2$ were found stable. (auth)

25145 EFFECTS OF RADIATION IN THE SURFACE LAYER OF POLYETHYLENE SAMPLES. Awatani, Jobu; Hashitani, Masahiko (Osaka Univ.). J. Soc. Mater. Sci., Jap., 15: 108-113(Feb. 1966). (In Japanese).

In order to study the effects of irradiation on the surface layer of polyethylene samples, percent crosslinking and gel-fraction of test pieces shaved down to the various thicknesses after irradiation were measured by means of a vibrating reed method and a Soxhlet extractor, respectively. Then the values of percent crosslinking and gel-fraction on each layer were calculated. At the internal layer the linear relation between $(1-g)+\sqrt{1-g}$ and $1/R$ has held as predicted by the theory of solubility, but approaching the surface this linearity has not held for samples irradiated in air. Moreover Young's moduli on the surface have behaved non-linearly for the dose. These results, however, could be comprehended if the proportion of the main chain unit fractured were not proportional to the irradiation dose on the surface. The value of $\dot{r}/2\dot{c}$, the ratio of the unit fractured to one crosslinked, reached 1.5 on the surface, about 3 times the value in the internal layer. Even on the layer near the surface where $\dot{r}/2\dot{c}$ is larger than unity, a considerable degree of gel-formation took place. By using the data of Young's modulus and gel-fraction measurements, the initial average molecular weight may be estimated. (auth)

25146 THEORIES OF SOLUBILITY OF CROSS-LINKED POLYMERS INDUCED BY IRRADIATION. Kuei, Tsu-t'ung; Wang, Tso-hsin. Kao Fen Tzu T'ung Hsun, 6: 1-12(1964).

The Charlesby and Tang theories of the solubility of polymers formed by radioinduced cross linking are discussed. Polymers with initial molecular weight distributions of the Flory type and of the Schulz type were considered. Four parameters were introduced for the internal structure of the cross-linked polymer. It is demonstrated that Charlesby's definition of sol fraction is correct and that his solubility formula was obtained when cross-linking density approaches zero. (TCO)

25147 GRAFT COPOLYMERIZATION OF STYRENE AND ACRYLONITRILE TO PREVIOUSLY IRRADIATED POLYETHYLENE FILM. Chang, Chih-p'ing; T'ang, Jung-pao; Ch'en, Lien-yung (Peking Chemical Engineering Research Inst. Peking Chemical Engineering Coll.). Kao Fen Tzu T'ung Hsun, 6: 269-78(1964).

The mechanism of the formation of macroradicals under the influence of γ-irradiation of polyethylene, as well as some of the properties of the graft copolymers produced were investigated. Comparative studies in which irradiation and copolymerization were carried out in the presence of hydrogen, air or in a vacuum showed, that only the temperature affects the results of copolymerization. The formation of a copolymer was proven by studies of solubility and by turbidity titration, and extraction showed that the content of polyacrylonitrile in the copolymer was less than 1%. When polyethylene was copolymerized with an appropriate amount of acrylonitrile, its softening point increased, it become less soluble in hot toluene, and its mechanical properties were improved. X-ray diffraction studies showed that the crystallinity of polyethylene decreases as the temperature increases. The effect on mechanical properties is ascribed to the increased formation of transverse bonds in the copolymer as the amount of acrylonitrile or styrene is increased. (ATD)

25148 STUDIES ON RADIATION POLYMERIZATION IN THE SOLID STATE. I. GAMMA-RADIATION POLYMERIZATION OF TRIOXANE. Ch'en, Chieh; Chang, Kuang-hsueh; Wang, Fu-yuan; Hsu, Chi-p'ing. Kao Fen Tzu T'ung Hsun, 7: No. 1, 12-17(1965).

The trioxane used was prepared from a 60 to 65% aqueous solution of formaldehyde in the presence of Lewis' acid catalyst. It was obtained from ether as hexagonal prismatic crystals (40 to 80 × 0.6 to 3 mm), which could be recrystallized from absolute ether in the form of needle-shaped crystals (30 to 50 × 0.3 to 0.6 mm). Both types of crystals were subjected to γ radiation from ^{60}Co in a vacuum and the effects of radiation dose (4.1 to 89 rad/sec) and temperature on the rate of polymerization and the specific viscosity of the product were determined. The results showed that, before the accumulated dose reached 2×10^5 rads, there was a straight-line relation between the radiation dose and the degree of conversion, which reached a maximum of about 74%. Within the range of radiation intensity studied, the rate of polymerization was found to be linearly dependent on the intensity of radiation, and the large hexagonal crystals showed a higher rate of conversion than the small needle-shaped crystals. The rate of conversion was also affected by the temperature of irradiation. Between −70 and 0°C, there was no polymerization. Above 30°C, the rate of conversion rose sharply with increasing temperature and was highest just below the melting point (62°C), above which polymerization ceased almost completely. The specific viscosity of the polymer produced was 0.8, and K_{222} was 3.4% per minute (before acetylation); the viscosity was found to decrease with an increase in total radiation dose but was not influenced by the intensity of the radiation. (ATD)

25149 γ-RADIOLYSIS OF AQUEOUS MANDELIC ACID SOLUTIONS. Brimacombe, J. S.; Milner, D. J. (Univ. of Birmingham, Eng.). Nature, 209: 1232(Mar. 19, 1966).

In γ radiolysis of deaerated 0.1 percent solution of DL-mandelic acid the primary products can be accounted for in terms of addition and disproportionation reactions of two radicals, namely, $PhC(OH)CO_2H$ and $Ph\dot{C}HOH$. A discussion of the formation of the latter radical by the decarboxylation of the former and by abstraction of a hydrogen atom from the carboxyl group of the acid is presented. (B.G.D.)

25150 RADIATION-INDUCED NITRATION OF AROMATIC COMPOUNDS IN ACIDIC, NEUTRAL AND ALKALINE AQUEOUS SOLUTIONS. Broszkiewicz, R. K. (Inst. of Nuclear Research, Warsaw). Nature, 209: 1235-6(Mar. 19, 1966).

An investigation of the radioinduced nitration of benzene and of phenol in acidic, neutral, and alkaline aqueous solutions is presented. (B.G.D.)

25151 RADIATION-INITIATED BLOCK POLYMERIZATION OF VINYLIDENE CHLORIDE. Roth, H. K. Plaste Kautschuk, 12: 137-40(1965).

1,1-Dichlorethylene (vinylidene chloride) was polymerized with the aid of 30 to 150 kv x radiation in the temperature range from −35 to 25°C in the absence of oxygen. The pri-

mary consideration in designing the polymerization vessels was the properties of the monomers and polymers of $C_2H_2Cl_2$. The vinylidene chloride used in this study was treated with triethylamine to prevent spontaneous polymerization. This additive was eliminated by double distillation immediately before the experiments. The yields were gravimetrically determined. As a result of the insolubility of the polymer in monomers a two-phase system was formed during polymerization. Radiographic determination of the crystallinity made it possible to determine to what extent the polymer prepared in the radiation field is dependent on the formation conditions. The influence of temperature is apparent not only from the kinetic data, but also from the degree of order of the polymer. (ATD)

25152 RADIOLYSIS OF AQUEOUS EMULSION OF A CHOSEN PETROLEUM FRACTION. **Bryl-Sandelewska, Teresa; Kecki, Zbigniew; Minc, Stefan; Nowak, Zofia; Stachowicz, Waclaw; Wincel, Henryk. Przem. Chem., 45: 59-62(1966). (In Polish).**

The gamma radiolysis of aqueous emulsions of a certain petroleum fraction (boiling within the range 210 to 340°C) in presence of oxygen or argon was studied. The influence of temperature, the dose absorbed, pH of the aqueous phase, and the character of gas passing through on the yield of radiolysis products was determined. The yield of peroxides was higher in the oil-water system than in an anhydrous one irradiated under the same conditions. (auth)

25153 ELECTRON SPIN RESONANCE IN IRRADIATED $MoO_4Na_2.2H_2O$. **Constantinescu, M.; Pascaru, I.; Constantinescu, O. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys., 11: 97-8(1966).**

An investigation was made to determine the mechanism for Mo(V) formation in irradiated compounds of Mo(VI). In a previous study the formation of Mo(V) was attributed to the reduction of Mo(VI) by hydrazine or other reducing groups. An irradiated polycrystalline compound not including the ammonium ion was studied by ESR. The ESR spectrum of a sample of this compound $MoO_4Na_2 \cdot 2H_2O$ and the variation of the ESR signal intensity with temperature are shown. (J.F.P.)

25154 EFFECTS OF γ-IRRADIATION ON POLYVINYLCHLORIDE. VII. γ-IRRADIATION OF PVC PLASTICIZED WITH TRICRESYL PHOSPHATE, Di-2-ETHYLHEXYL SEBACATE AND MIXED PLASTICIZER OF THEM. Kimura, Tadashi (Osaka Municipal Technology Research Inst.). Sci. Ind. (Tokyo), 39: 753-6(Dec. 1965). (In Japanese).

The effects of γ irradiation on PVC sheets plasticized with tricresylphosphate (TCP), di-2-ethylhexyl sebacate (DOS), and mixtures of various compositions of them were examined by the determination of gel content, chlorine content, and average degree of polymerization of PVC extracted from each irradiated specimen. PVC undergoes predominantly cross-linking reactions. From the comparison of polymerization degree and gel content of PVC, it is concluded that TCP has a stronger protective effect on the γ-ray-induced decomposition of PVC than DOS. (auth)

25155 EFFECTS OF γ-IRRADIATION ON POLYVINYLCHLORIDE. VIII. γ-IRRADIATION OF PVC PLASTICIZED WITH TRICRESYL PHOSPHATE, TRI-2-ETHYLHEXYL PHOSPHATE AND THEIR MIXTURES. Kimura, Tadashi (Osaka Municipal Tech. Research Inst.). Sci. Ind. (Tokyo), 39: 757-60(Dec. 1965).

The effects of γ irradiation on PVC plasticized with tricresyl phosphate (TCP), tri-2-ethylhexyl phosphate (TOP), and their mixtures were studied. PVC seemed to undergo predominantly cross-linking after a dose of 4×10^7 R since an increase of polymerization degree was observed, but gel formation did not occur up to a dosage of 6.5×10^7 R. From comparison of the polymerization degree of decomposed PVC, it is obvious that TCP exerts a stronger protective effect upon the decomposition of PVC by γ rays than TOP. (auth)

25156 RADIATION CHEMISTRY TRANSFORMATIONS OF THIOCYANATES IN ACETIC ACID. **Ivanitskaya, L. V. (Inst. of Inorganic Chemistry and Electrochemistry, Academy of Sciences, Georgian SSR). Soobshch. Akad. Nauk Gruz. SSR, 41: 567-71(Mar. 1966). (In Russian).**

The radiochemical transformation of potassium and ammonium thiocyanates was investigated as a function of energy absorption, dose, temperature, solution concentration, and medium. It was established that the radiochemical transformations of potassium and ammonium thiocyanates proceed with yields characteristic for chain reactions. (tr-auth)

25157 EXPERIMENTAL INVESTIGATION OF THE IRRADIATION OF CARBON DIOXIDE GAS AT NONEQUILIBRIUM TEMPERATURES. [PART] II. **Chukanova, L. A.; Nevskii, A. S. (All-Union Research Inst. for Metallurgical Heat Tech., USSR). Teplofiz. Vysok. Temp., 3: 577-86(1965).**

Irradiation of the gas was carried out in two coaxial chambers with a beam length of 163 mm in each chamber. Along the axis of the chamber were a radiometer for measuring irradiation of the gas and a hot or cold black body. A mixture of carbon dioxide gas and nitrogen was blown through the chambers at different temperatures in each chamber. Each chamber consisted of an inner volume in which irradiation was measured, and an outer annular space in which the gas was heated. Three series of experiments were carried out: with identical temperatures and carbon dioxide concentrations in both chambers, with different temperatures but identical concentrations, and with different temperatures and concentrations in both chambers. Tests were made at nonequilibrium temperatures up to 900°C. Experimental values agreed well with calculated values. For calculation of the temperature dependence of gas absorption, an approximate method based on the assumption of lack of dependence of the spectral coefficients of the absorbing medium on its temperature is recommended. This method was verified up to 900°C. (ATD)

25158 HYDROXYL RADICALS IN THE γ RADIOLYSIS OF AQUEOUS BENZENE SOLUTIONS. Tsuda, Minoru. Tokyo Kogyo Shikensho Hokoku, 61: 80-3(Feb. 1966). (In Japanese).

Experiments were carried out in order to prove the hypothesis that the hydroxyl radical plays an important role in the oxidation of organic compounds by γ radiolysis in aqueous solutions. Nitrous oxide and hydrogen peroxide were found to be capable of converting radioinduced hydrogen atoms (or their stoichiometrically-equivalent species) to hydroxyl radicals. In the γ radiolysis of aqueous benzene solutions in the presence of nitrous oxide or hydrogen peroxide, the yield of the oxidation products from benzene was found to equal, as was expected, the sum of the yields of hydrogen atoms and hydroxyl radicals from water. (auth)

25159 REACTION OF ACETYLENE WITH γ RADIATION UNDER PRESSURE. I. Yashiro, Dairokuro. Tokyo Kogyo Shikensho Hokoku, 61: 84-7(Feb. 1966). (In Japanese).

Acetylene was polymerized by gamma radiation under pressure in the range from 5 to 10 kg/cm^2 (gage) and in the temperature range from 10 to 150°C. The main product of the reaction was a yellowish, insoluble, nonvolatile, and infusible powder that was similar to the cuprene-like polymers that were induced by radiations other than γ rays under the pressures lower than atmospheric pressure. The formation of benzene in small amounts was also detected and identified by means of gas chromatographic and ultraviolet spectroscopic analyses. The values of $G(-C_2H_2)$ for polymer formation and $G(C_6H_6)$ were about 30 and 10, respectively. There was no definite effect on the rate of the reaction with the addition of the inert gases (nitrogen or argon) in the reaction system. The increase in the surface-volume ratio in the reaction vessel was not affected by the rate of reaction. (auth)

25160 INVESTIGATION OF RADIATIVE PROCESSES IN AQUEOUS MEDIA IN RELATION TO CERTAIN PROBLEMS OF HYDROMETEOROLOGY AND NUCLEAR RADI-

ATION DOSIMETRY. Dmitriev, M. T. Tr. Nauch.-Issled. Inst. Gidrometeorol. Priborostr., 13: 53-79(1965). (In Russian).

Radiative processes in aqueous media leading to the formation of compounds of bound nitrogen are described. It was established that monitoring for these processes makes possible the dosimetry of absorbed ionizing radiation and also the determination of different characteristics of the aqueous media. (tr-auth)

25161 SOME RADIOLYTIC HOMOGENEOUS REACTION MECHANISMS UNDER CONTINUOUS AND INTERMITTENT IRRADIATION. Burns, W. G. (Atomic Energy Research Establishment, Harwell, Eng.); Barker, R.; Lewis, B. A.; York, E. J. Trans. Faraday Soc., 61: 2686-2700(Dec. 1965).

Steady-state equations were solved for one- and two-radical models consisting of first- and second-order reactions. The results give the dependence of concentrations and of G-values on dose rate. In the two-radical model two cases are distinguished; 2(a), in which the first-order reactions are independent, and 2(b), in which the first radical forms the second in its first-order reaction. Case 2(b) is extended to a three-radical case. Analyses of the intermittent irradiation equations for cases (1) and 2(b) were made, and applications of the mechanisms to previous experiments are pointed out. It is shown that absolute rate constants may be determined from observation of the transition in G value with dose rate as a function of pulse frequency with intermittent irradiation. (auth)

25162 RADIATION-INDUCED POLYMERIZATION OF POLYFUNCTIONAL VINYL SILOXANES. Konobeevskii, K. S.; Gusel'nikov, L. E.; Nametkin, N. S.; Polak, L. S.; Chernysheva, T. I. (Inst. of Petroleum-Chemical Synthesis, Academy of Sciences, USSR). Vysokomol. Soedin., 8: 553-6(Mar. 1966). (In Russian).

The action of γ rays on monomeric polyfunctional vinylsiloxanes was studied. At low temperatures there was no polymerization and the monomers decomposed to gaseous and liquid (dimers) products. At higher temperatures polymers were formed. The existence of stabilized free radicals in soluted polymer proved its microgel character. Based on the example of styrene polymerization initiated with a microgel of 1,3,5-trivinyl-1,1,3,5-pentamethyltrisiloxane, the possibility of copolymers preparation by this method was demonstrated. (auth)

25163 RADIATION-INDUCED POLYMERIZATION OF POLYFUNCTIONAL ALLYL SILANES. Boken, Yun; Gusel'nikov, L. E.; Nametkin, N. S.; Polak, L. S.; Chernysheva, T. I. (Inst. of Petroleum-Chemical Synthesis, Academy of Sciences, USSR). Vysokomol. Soedin., 8: 557-9(Mar. 1966). (In Russian).

Kinetic features of radioinduced polymerization of diallyl silanes were studied in polymerization of blocks of diethyldiallylsilane. The dependence of the reaction order on dose rate, the activation energy, and the solvent effects was determined. (auth)

25164 LIGHT OUTPUT OF α PARTICLES IN CRYSTALLINE AND VAPOR FORMS OF ANTHRACENE. Strothmann, Helmut (Univ., Goettingen, Ger.). Z. Phys., 192: 51-62(1966). (In German).

The light output, S_v, by α particles stopped in anthracene vapor was measured as a function of vapor pressure and temperature. The comparison of the results for an idealized vapor neglecting collisions with the light output, S_c, from anthracene crystals by α particles impinging parallel to the c'-axis yielded the unexpected results: S_v(8.78 Mev)/S_c(8.78 Mev) = 0.46 ± 0.05 and S_v(6.05 Mev)/S_c(6.05 Mev) = 0.57 ± 0.08. A simple model that assumes quenching collisions of the vapor molecules is proposed to explain the observed dependence of the light output on the vapor pressure at fixed temperature. (G.O.Y.)

25165 STUDIES OF RADIATION INDUCED CHEMILUMINESCENCE. Hoefert, M. Munich, Univ., 1964. 73p. $2.00 Gmelin, AED-Diss. 64-1061.

Construction of an apparatus for measuring very small light intensities of the order of 10^3 photons/cm^2 sec using a photomultiplier and pulse counting device is described. The influence of light and x rays on oxidation of unsaturated fatty acids was studied. Activation energies were calculated from the temperature dependence of the light emission. Possible application of this method to radiation biology is discussed. (Gmelin Inst.)

25166 PROCEEDINGS OF THE NUCLEAR AND RADIATION CHEMISTRY SYMPOSIUM, BOMBAY, MARCH 16–19, 1964. Trombay, India, Atomic Energy Establishment, 1965. 238p. (CONF-640308).

Papers on chemical behavior of heavy elements, radiation chemical effects in solids and solutions, and use of radioisotopes in chemistry were presented. Separate abstracts were prepared for 34 of the 41 papers included. (M.C.G.)

For abstracts of individual papers see: 25001–25007, 25075–25085, 25167–25175, 25204, 25205, 25295, 25448, and 26190–26192.

25167 EFFECT OF IODINE AND METHYL IODIDE ON RADIOLYSIS OF WATER. Rama Rao, K. V. S.; Kamala, R.; Jain, S. K. (Atomic Energy Establishment, Trombay, India). pp 73-8 of Proceedings of the Nuclear and Radiation Chemistry Symposium, 1964. Trombay, India, Atomic Energy Establishment, 1965.

Solutions of ferrous ammonium sulfate in 0.8N sulfuric acid, containing varying concentrations of iodine or methyl iodide were irradiated with γ rays from a ^{60}Co source in the presence and absence of air. Ferric yields were measured spectrophotometrically using unirradiated solutions as a blank. Iodine was found to diminish G(Fe^{3+}) even at concentrations of 10 micromoles per liter while methyl iodide had no appreciable influence until its concentration exceeded millimolar quantities. The results are explained in terms of a competition for H atoms between iodine or methyl iodide and dissolved oxygen. The relative rate constants for scavenging of H atoms by these solutes were established. The efficiency for scavenging H atoms diminished in the order $I_2 > O_2 > CH_3I$. In deaerated solutions H-atoms oxidized ferrous ions in acid solutions. Such oxidation was prevented in presence of iodine or methyl iodide due to a preferential reaction of H atoms with these solutes. (auth)

25168 SOME REMARKS ON THE COURSE OF RADIOLYSIS IN AQUEOUS HYDROCHLORIC ACID SOLUTIONS. Mazumdar, A. S. Ghosh; Natarajan, P. R.; Srinivasan, B. (Atomic Energy Establishment, Trombay, India). pp 79-85 of Proceedings of the Nuclear and Radiation Chemistry Symposium, 1964. Trombay, India, Atomic Energy Establishment, 1965.

Results obtained in the radiolysis of plutonium(III) in mixtures of lithium chloride and hydrochloric acid solutions with a total chloride ion concentration of 8M are presented and discussed in terms of mass absorption effects. Radiolysis of ferrous chloride in 0.4 to 4M hydrochloric acid solutions in the presence of oxygen was also studied for comparing the direct effect with that observed in the case of plutonium solutions. (auth)

25169 APPLICATIONS OF NUCLEAR RADIATIONS IN POLYMERIZATION PROCESSES. Singh, Harcharan; Thampy, R. T.; Chilpalkatti, V. B. (Shri Ram Inst. for Industrial Research, Delhi). pp 86-91 of Proceedings of the Nuclear and Radiation Chemistry Symposium, 1964. Trombay, India, Atomic Energy Establishment, 1965.

Gamma rays are used in the polymer chemistry in three ways: polymerization of a monomer or copolymerization of two monomers to synthesize a new polymer or copolymer; graft polymerization of a monomer onto an already formed natural or synthetic polymer; cross-linking of a polymer to get a more infusible and insoluble product or with another monomer to get an insoluble and infusible product. The process of polymerization can be carried out in two ways: addition polymerization and condensation polymerization. The use of nuclear radiation in polymerization processes depends on its ability to form free radicals with monomers

containing ethylenic unsaturation or by the abstraction of a proton from a polymer to form a free radical without degradation or by breaking the polymer molecule into two or more fragments containing free radicals. The polymerization process initiated with nuclear radiation probably proceeds via a free radical mechanism. Applications of nuclear radiations are discussed. (auth)

25170 RADIATION EFFECTS ON COTTON CELLULOSE. Chipalkatti, V. B.; Pande, A. (Shri Ram Inst. for Industrial Research, Delhi). pp 92-6 of Proceedings of the Nuclear and Radiation Chemistry Symposium, 1964. Trombay, India, Atomic Energy Establishment, 1965.

Effects of radiation on cellulose are reviewed. Effects on crystallinity, polymerization, dyeing, and on modified cottons are described. Applications of radiation in wash and wear treatments and in grafting and polymerization onto cellulose are discussed. (M.C.G.)

25171 THERMAL DECOMPOSITION OF IRRADIATED MANGANESE CARBONATE. Mohanty, S. R.; Ray, M. N. (Banaras Hindu Univ., India). pp 112-17 of Proceedings of the Nuclear and Radiation Chemistry Symposium, 1964. Trombay, India, Atomic Energy Establishment, 1965.

The thermal decomposition of manganese carbonate, unirradiated and irradiated with ^{60}Co γ rays, was investigated at different temperatures in the range from 170 to 290°C. Irradiation enhanced the decomposition. The Prout–Tompkins equation was applicable to both the acceleratory and the decay stages of the pressure-time sigmoid with a different constant for each stage. The acceleratory region was also described by an exponential equation. The activation energy was not significantly altered by irradiation. (auth)

25172 RECOIL CHEMISTRY OF ^{60}Co IN CERTAIN NEUTRON IRRADIATED Co(III) AMMINES. Shankar, J.; Srinivasan, S. C. (Atomic Energy Establishment, Trombay, India). pp 118-23 of Proceedings of the Nuclear and Radiation Chemistry Symposium, 1964. Trombay, India, Atomic Energy Establishment, 1965.

The recoil chemistry of ^{60}Co formed as a result of (n,γ) reactions in hexammino Co (III) nitrate, aquopentammino Co (III) nitrate, nitropentammino Co (III) nitrate, and nitrato pentammino Co (III) nitrate was investigated by paper electrophoresis. The experiments indicated that no tetrammino Co (III) complexes are formed in the process. At high neutron doses, ^{60}Co was not found as hexammino Co (III), the predominant species were nitropentammino Co (III) and cobalt (II). The hexammino species was noticeable only at lower neutron doses. The effects of fast neutrons on yields of the complex species were established. Gamma irradiation subsequent to the neutron irradiation of hexammino Co (III) did not change the distribution pattern. In substituted pentammino complexes, a common product was nitropentammino Co (III). (auth)

25173 PAPER ELECTROPHORETIC STUDIES ON PILE-IRRADIATED BIS-SALICYLALDEHYDE TRIETHYLENE TETRAMINE COBALT(III) CHLORIDE [$CoTS_2 \cdot Cl$, 2.5 H_2O]. Rao, K. Annaji (Atomic Energy Establishment, Trombay, India). pp 124-7 of Proceedings of the Nuclear and Radiation Chemistry Symposium, 1964. Trombay, India, Atomic Energy Establishment, 1965.

Electrophoretic separations of pile-irradiated complexes were carried out in NaA–HA buffer. Two species, Co^{2+} and $CoTS_2^+$, were found. When the same experiments were carried out with 1% EDTA (disodium salt), three species were detected, [Co (II) EDTA]$^{2-}$, [Co (III) EDTA]$^-$, and [Co TS_2]$^+$. The presence of [Co (III) EDTA]$^-$ reveals the existence in the irradiated complex of a degraded Co (III) species. On thermal annealing, [Co TS_2] was formed at the expense of Co (II) and Co (III) species. (auth)

25174 SOME STUDIES OF SECONDARY REACTIONS OF RECOIL ^{82}Br ATOMS UNDER (n,γ) PROCESS. Shukla, B. M.; Mishra, S. R. (Banaras Hindu Univ., India). pp 128-33 of Proceedings of the Nuclear and Radiation Chemistry Symposium, 1964. Trombay, India, Atomic Energy Establishment, 1965.

Studies in hot atom chemistry during the last few years showed that ion-molecular reactions play an important role in chemical processes accompanying nuclear transformations. In order to explain the complex physicochemical processes in stabilization of the recoil ^{82}Br atoms, and to elucidate the limit of applicability of the theory of elastic collision, $C_2H_5Br-C_6H_6$ mixtures with varying concentrations (0.5M to 3.0M) of C_2H_5Br in the liquid phase were subjected to (n,γ) processes and secondary reactions by way of H-substitution products were studied. With increases in C_2H_4Br concentration, there was an overall increase in the yield of H-substituted products, which subsequently tended to a saturation limit. The influence of elementary bromine (0.03M) as a scavenger in 1.0M C_2H_5 Br–C_6H_6 mixture showed an absence of H-substitution products. A scheme for the H-substitution process is suggested and the results discussed critically in the light of known theories. (auth)

25175 THE CATALYTIC DECOMPOSITION OF HYDROGEN PEROXIDE BY REACTOR IRRADIATED NEODYMIUM OXIDE. Virmani, Y. P. (Atomic Energy Establishment, Trombay, India). pp 134-7 of Proceedings of the Nuclear and Radiation Chemistry Symposium, 1964. Trombay, India, Atomic Energy Establishment, 1965.

The neodymium oxide was irradiated to an integrated flux of 5×10^{16} neutrons/cm^2. The kinetics of the catalytic decomposition of H_2O_2 at the surfaces of both irradiated and unirradiated samples was studied at several temperatures. The reaction followed first order kinetics. The reaction rate was altered by irradiation to a slight extent only. However, the activation energy showed a definite decrease with irradiated catalyst. The studies indicated the absence of a β^- radiation effect on the course of the reaction. Thermal annealing of the irradiated oxide profoundly affected the reaction rate, while the activation energy assumed an intermediate value between irradiated and unirradiated Nd_2O_3. (auth)

25176 IMPROVEMENTS IN PRODUCTION OF GRAFT POLYMERS OR COPOLYMERS BY THE USE OF RADIATION. (to Unisearch Ltd.). British Patent 1,022,528. Mar. 16, 1966. Priority date Nov. 19, 1963, Australia.

A method is described for the production of graft polymers or copolymers by radiation in which a backbone polymer, such as cellulose in the form of paper, wood pulp, or wood or wool fibers, is irradiated in the presence of a solution of a monomeric vinyl compound polymerizable by free radical or ionic mechanism or monomeric methyl methacrylate in a solvent. The solvent must be capable of swelling the backbone polymer to enable the monomer to gain access to the active sites and is generally, but not exclusively, a solvent having a high dipole moment. Suitable monomeric compounds are styrene, methyl methacrylate, and 4-vinylpyridine. Any homopolymer formed during the irradiation step is dissolved out. (B.L.M.)

25177 IRRADIATED BATTERY SEPARATOR MEMBRANES. Greminger, George K. Jr.; Beaver, Garth H. (to Dow Chemical Co.). U. S. Patent 3,235,409. Feb. 15, 1966. Filed July 14, 1961.

A superior ion permeable membrane can be prepared by subjecting a layer of an aqueous sol or dispersion containing from about 1 up to 50 wt % of certain hydroxyalkyl methyl cellulose ethers to a dose of high energy radiation of from about 0.25 to 5 Mrads. The wet bibulous layer can be utilized for an ion-permeable water-insoluble membrane as produced, or it can be subsequently dried at moderate temperature for more convenient handling and manipulation. Upon rewetting, the dried hydrophilic layer can absorb several times its weight of water to provide a membrane comparable to that initially obtained. Such membranes can also be prepared on an ion-permeable water-insoluble support backing. Combination of the membrane produced with a soluble metallic anode, an insoluble cathode, a depolarizer, and an electrolyte yields a primary galvanic dry cell. (B.L.M.)

25178 GRAFT POLYMERIZATION ON A PAPER BASE BY IONIZING RADIATION. Degering, Edward F.

(to U. S. Army). U. S. Patent 3,236,584. Feb. 22, 1966. Filed Nov. 8, 1962.

A method of grafting a polymeric coating on the cellulose molecules of paper consists of exposing the paper surface coated with a monomer having a polymerizable vinyl group to several successive exposures of high energy ionizing radiation at controlled low dosages, which are individually non-injurious to the base. Between exposure intervals, the paper is heated at elevated temperatures of about 40–85°C. The high energy radiation must be equivalent to at least about 100,000 ev at a dosage but not more than about 100,000 rads per pass. The method is also applicable to a polymeric coating of the silicone type and to keratinous and plastic bases as well as cellulose. (B.L.M.)

25179 GRAFT POLYMERIZATION OF AN ORGANOSILOXANE COATING ON LEATHER BY IONIZING RADIATION. Degering, Edward F. (to U. S. Army). U. S. Patent 3,236,923. Feb. 22, 1966. Filed Nov. 8, 1962.

A method is described for converting comminuted leather into sheet material by chemically grafting an organosiloxane onto the leather. The comminuted leather is impregnated with a polymerizable organosiloxane, pressed into sheets, and exposed to a high intensity ionizing radiation equivalent to at least 100,000 ev at a dosage of not more than about 2 megarads per pass for several successive passes. The dosage should be less than that necessary to completely polymerize the organosiloxane. An interval of at least 15 min is allowed to elapse between successive exposures, and the passes are continued until the siloxane is completely polymerized. (B.L.M.)

Radiochemistry

See also Separation Processes and Procedures

Refer also to abstracts 24992, 25120, and 26431.

25180 (BNL–954, pp 84-113) RADIATION DIVISION. Manowitz, B. (Brookhaven National Lab., Upton, N. Y.).

Research is reported on solid state reactions, radioinduced polymerization, chemonuclear processes, and use of ^{60}Co in radioinduced chemical reaction of commercial potential. Operation of a high-intensity radiation development laboratory is described. Performance of methacrylate dosimeters is discussed, and calibration of radiation sources is reported. Development work on radiation sources is summarized. Design studies of photoreactors are described along with those concerned with recycle accelerators. Design and performance of alpha-source calibration equipment is discussed along with effects of electric discharge on fluidized and fixed beds. (J.R.D.)

25181 RADIOISOTOPE SEPARATORS AND MASS SPECTROMETERS IN NUCLEAR AND RADIOCHEMISTRY. Bruninx, E. (CERN, Geneva). At. Energy Rev., 4: 107-48(1966).

The most common types of laboratory radioisotope separators and mass spectrometers are discussed. Emphasis is placed on their performance and their advantages and disadvantages. The use of these instruments in nuclear and radiochemistry, nuclear spectroscopy of short or long-lived nuclides, labeling, and range studies is examined. (auth)

25182 WORK METHODS IN HOT LABORATORIES. Cesarano, Catello. Comit. Naz. Energ. Nucl., Notiz., 12: 45-8(Feb. 1966). (In Italian).

The development of hot laboratories is outlined, and a survey of the methods used in hot laboratories is presented. Some special problems involving the handling of alpha- and gamma-emitting substances are also discussed. (D.C.W.)

25183 PREPARATION OF ^{51}Cr OF HIGH SPECIFIC ACTIVITY FOR MEDICAL USE. Mani, R. S.; Chowdhary, S. Y. (Atomic Energy Establishment, Trombay, India). Curr. Sci. (India), 35: 230-2(May 5, 1966).

Preparation of ^{51}Cr of high specific activity and purity by recoil enrichment, using pure crystalline potassium chromate as the target is described. An optimum irradiation of 3 to 6 days at a neutron flux of 50 to 150 × 10^{11} $n/cm^2/sec$ gave a product of high specific activity (100 C per gram), suitable for medical use. Cation exchange separation, direct precipitation, and precipitation on a column of alumina can be used for the chemical separation of enriched ^{51}Cr. (F.J.H.)

25184 THE ANALYTICAL USE OF THE MOESSBAUER EFFECT IN THE TAGGED ATOM METHOD. Stukan, R. A.; Gol'danskii, V. I. (Inst. of Chemical Physics, Academy of Sciences, SSSR). Dokl. Akad. Nauk SSSR, 165: 1347-9(Dec. 21, 1965). (In Russian).

A method is described which consists in successively enriching each of the reacting components in the given complex system with the Mössbauer isotope of the element which is in the given component (for example ^{57}Fe, ^{119}Sn) and then studying the changes in the Mössbauer spectrum of the reaction products as compared with the spectrum of the natural isotope components. Variations can be extremely fruitful in the study of rapid redox processes or isotope exchange and also for the study of chemical processes at low temperatures. The experiments were conducted with F^{2+} and Fe^{3+} ions in Cl^-- and SO_4^{2-}-containing media at pH ~ 1. The Mössbauer spectra were measured on an electrodynamic 500-channel gamma resonance spectrometer. Cobalt-57 was used as the gamma source. All measurements were taken at liquid nitrogen temperature. The two starting solutions contained: 8 mg of Fe^{3+} ions 60% enriched with ^{57}Fe isotope and 12 mg Fe^{2+} with natural content of ^{57}Fe. After obtaining the Mössbauer spectra on the starting solutions they were mixed in a cuvette and frozen at 80°K. After mixing, the spectral parameters of the solution are characteristic for Fe^{2+} with higher line intensities than in the starting solution of Fe^{2+} indicating increase of the concentration of ^{57}Fe in the Fe^{2+} form due to the electron exchange reaction $^{57}Fe^{3+} + Fe^{2+} \rightleftharpoons {}^{57}Fe^{2+} + Fe^{3+}$. The Fe^{3+} line is weak due to the very small f' for Fe^{3+} ion and the high degree of electron exchange. Changes in the spectrum in the course of the 2 hr measurement period indicate that some electron exchange takes place in the frozen solutions at 80°K. The experiment shows the effectiveness of this method in the investigation of electron and isotope exchange. In the investigated system electron exchange between Fe^{2+} and Fe^{3+} proceeds rapidly, but at a measurable rate. (ATD)

25185 PREPARATION OF TRITIUM-LABELED POLYMETHACRYLIC ACID METHYL ESTER. Meyerhoff, G.; Meier, W.; Berger, K. (Johannes Gutenberg Univ., Mainz). Makromol. Chem., 91: 290-9(1966). (In German).

A method is described for the preparation of identical fractions of tritium-labeled and unlabeled fractions of the methyl ester of polymethacrylic acid of higher molecular weights. Labeling is done with TOH in polymethacrylic acid and does not change the molecular weight distribution. Thus the molecular weight values based on viscosity, weight average, and number average were 720,000, 799,000, and 610,000 for the ^3H-labeled and 700,000, 737,000, and 455,000 for the unlabeled polymer. Also investigated was the effect of labeling on the fractionated methyl ester of polymethacrylic acid. The molecular weight distributions before and after exposure to 3 C of tritium gas were determined. These data made it possible to gain information concerning the number of bonds broken and of the position of the active hydrogen atoms in the polymer chain. Thus the weight average and number average molecular weight values were 301,000 and 101,000 for the ^3H-labeled and 935,000 and 725,000 for the unlabeled polymer, indicating considerable degradation of the tritiated preparation. (BBB)

25186 PREPARATION OF SOME LABELED PURINE DERIVATIVES AND THEIR BEHAVIOR IN METABOLISM. Ballweg, H. (Univ., Heidelberg). Nucl.-Med., Suppl. 3, 151-5(1965). (In German).

The preparation of various labeled (^{14}C and ^{3}H) isomers of biologically effective N^{NH_2}-puryl-6-substituted compounds (N^{NH_2}-puryl-6-histamine(6-histaminopurine) and ϵ-puryl-6-L-lysine) is described. During the incubation of labeled 6-histaminopurine liver cells, the compound was separated in a short time into a purine and an imidazole derivative. In contrast, under the same conditions, cells of ascites tumors are not capable of splitting the compound. In vivo, a part of the 6-histaminopurine was separated unaltered after injection into healthy mice, whereas in animals with ascites tumors this is not the case. (tr-auth)

25187 HOT ATOM CHEMISTRY OF ^{76}As USING BENZENEARSONIC ACID AS A TARGET. Suzuki, Shin; Inoue, Yasushi; Kishimoto, Mokuyoshi. Sci. Rep. Res. Inst., Tohoku Univ., Ser. A, 17: 293-9(Dec. 1965).

The enrichment of ^{76}As by means of the hot atom effect of neutron capture reaction was carried out using benzenearsonic acid as a target. Arsenites were carefully removed in advance from benzenearsonic acid. After irradiation for 2 hr in the pneumatic tube of atomic pile JRR-1 (thermal neutron flux $\sim 10^{11} n/cm^2 \cdot sec$), benzenearsonic acid was dissolved in 12 ml of 11N hydrochloric acid. The resulting solution was shaken with 10 ml of benzene and the recoil arsenic was extracted into the benzene layer. The layer was stripped with water, and ^{76}As was obtained in an aqueous solution. The enrichment method is advantageous in that radiochemically and chemically pure ^{76}As is obtained by comparatively simple and rapid procedures in a single oxidation state of trivalency in dilute hydrochloric acid solution. It was found that the retention value of recoil fragments was about 15 to 20% and about 80% of it was present in trivalent state. (auth)

25188 SOME NEW APPLICATIONS OF THE MOESSBAUER EFFECT IN CHEMISTRY. Golding, R. M. (Department of Scientific and Industrial Research, Petone, New Zealand). pp 26-35 of STI-DOC-10/50.

The dependence of ΔE_Q on the electron wave functions in some iron complexes is discussed, together with the isomeric shift. The relation of Mössbauer spectroscopy to other forms of spectroscopy is also considered. (D.C.W.)

25189 COMITE CONSULTATIF POUR LES ETALONS DE MESURE DES RADIATIONS IONISANTES, 5e SESSION, 1964, 28-29 SEPTEMBRE. (Consultative Committee for Standards of Measurement of Ionizing Radiations, 28-29 Sept., 1964). Paris, Gauthier-Villars and Cie, [1964]. 106p. (CONF-640923).

Five reports given at the fifth session are reported. Separate abstracts were prepared for 4 of the 5 papers. (M.C.G.)

For abstracts of individual papers see: 25190–25193.

25190 ANALYSIS OF RESULTS OF THE INTERNATIONAL COMPARISON OF ^{35}S. Roy, J. C.; Rytz, A. pp 28-48 of Comite Consultatif pour les Etalons de Mesure des Radiations Ionisantes. Paris, Gauthier-Villars and Cie, 1964. (In French).

The specific activity of a ^{35}S solution was measured by 15 laboratories using 6 different methods. The 20 results obtained showed a considerable spread and are evidence of the presence of important systematic errors. The different methods are discussed separately and various sources of errors are analyzed. Different techniques of special treatment of supports and sources are examined in detail. Further measurements are considered before definite conclusions about the standardization of this low-energy pure β emitter are possible. (auth)

25191 REPORT ON THE INTERNATIONAL COMPARISON OF ^{241}Am. Rytz, A. pp 49-66 of Comite Consultatif pour les Etalons de Mesure des Radiations Ionisantes. Paris, Gauthier-Villars and Cie, 1964. (In French).

Twenty-one laboratories took part in an international comparison of the solution of an α emitter. Problems regarding source preparation seemed to exist, but no dilutions were necessary. As much as 39 more or less independent results are reported, 23 of which were used in a calculation of the most probable value of the specific activity: $11.29\ s^{-1}\ mg^{-1} \pm 0.2\%$. (auth)

25192 REPORT ON THE INTERNATIONAL COMPARISON OF THE $4\pi\beta$(PC)-γ METHOD BY MEANS OF ^{60}Co. Rytz, A. pp 67-102 of Comite Consultatif pour les Etalons de Mesure des Radiations Ionisantes. Paris, Gauthier-Villars and Cie, 1964. (In French).

Seventy-eight solid sources of ^{60}Co gave a survey of the mutual agreement between $4\pi\beta$(PC)-γ measurements made in different parts of the world: any two laboratories measuring the same source agreed in 95% of the cases within less than 0.61%. The corrections to be applied to the measurements and the sources of error inherent to $4\pi\beta$-γ counting were analyzed. The decay scheme dependent correction was found to be adequately expressed by $(1-\epsilon_\beta)/\epsilon_\beta$ multiplied by a constant that has to be determined experimentally. The measurements of the specific activity of a ^{60}Co solution distributed simultaneously showed a dispersion of 1.4% as compared to 3.1% obtained 14 months earlier. The presence of systematic errors due to various manipulations of solutions is considered probable. Some evidence of a systematic difference of about 0.5% in the method used for determining the mass of the aliquot is advanced. (auth)

25193 ANALYSIS OF RESULTS OF THE INTERNATIONAL COMPARISON OF SIX STANDARDS OF HOENIG-SCHMID RADIUM. Rytz, A. pp 103-6 of Comite Consultatif pour les Etalons de Mesure des Radiations Ionisantes. Paris, Gauthier-Villars and Cie, 1964. (In French).

During the period from October 1963 to February 1964, the radium standard No. 5427 was compared with five other Hönigschmid standards in several laboratories. The main features of the ionization chambers and calorimeters used are described briefly and the results obtained are compared with some earlier measurements. The standard errors reported vary from two to ten parts in 10,000. (auth)

25194 METHOD FOR THE PRODUCTION OF ^{132}Cs OF HIGH RADIOCHEMICAL PURITY. Tanaka, Kichizo; Kuroyanagi, Tokihiro; Tamura, Tsutomu; Shibata, Nagao (to Nihon Genshiryoku Kenkyu Sho). German Patent 1,208,421. Jan. 5, 1966. Priority date Nov. 2, 1962, Japan.

^{132}Cs is obtained by irradiating an organic or inorganic compound of Cs with bremsstrahlung with a maximum energy of more than 10 Mev, thereby using the nuclear reaction $^{133}Cs(\gamma,n)^{132}Cs$. (Gmelin Inst.)

25195 APPARATUS FOR MEASURING THE ACTIVITY OF LOW-ENERGY BETA IRRADIATORS IN A LIQUID SCINTILLATOR. Hoegl, Alois; Schwerdtel, Eberhard (to Frieseke and Hoepfner GmbH). German Patent 1,211,341. Feb. 24, 1966. Filed Dec. 20, 1963.

The activity of a low-level beta emitter dissolved in a liquid scintillator is measured by means of three photomultiplier tubes operated in triple coincidence to suppress background pulses. (Gmelin Inst.)

Separation Processes and Procedures

See also Analytical Procedures
ISOTOPE TECHNOLOGY — Separation and Production

Refer also to abstracts 25033, 25036, 25229, and 25530.

25196 (INR-677/V/XIII/C) ZASTOSOWANIE CHROMATOGRAFII PODZIALOWEJ Z ODWROCONYMI FAZAMI DO WYDZIELANIA MIKROILOSCI KOBALTU Z TARCZY NIKLOWEJ. (The Application of Reversed-Phase Partition Chromatography to the Separation of Microamounts of Cobalt from Irradiated Nickel). Smulek, Wiktor; Zelenay,

Krystyna (Institute of Nuclear Research, Warsaw (Poland)). Dec. 1965. 14p. (CONF-660413-1). Dep.

From Conference on Application of Physico-Chemical Methods in Chemical Analysis, Budapest.

Reversed-phase partition chromatography was applied to the separation of microamounts of ^{58}Co from the neutron irradiated nickel target. Tri-n-octylamine retained on silica gel was used as the stationary phase and elution was carried out with hydrochloric acid of varying concentration, water, and other eluants. The method was found to give a better separation of both the metals than with Dowex 1 × 10 or Amberlite IRA-400. (auth)

25197 (ORNL-3903) ION-EXCHANGE SEPARATION OF CURIE QUANTITIES OF ^{90}Y FROM ^{90}Sr WITH DTPA AND HEDTA. Orr, P. B. (Oak Ridge National Lab., Tenn.). May 1966. Contract W-7405-eng-26. 20p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Twelve ion-exchange systems were investigated that used varied pH values and concentrations of diethylenetriaminepentaacetic acid (DTPA) and N-hydroxyethylethylenediaminetriacetic acid (HEDTA) to separate curie quantities of ^{90}Y from ^{90}Sr. Several systems gave high-purity ^{90}Y, and in all systems the chelating agents were destroyed by fuming with HNO_3. A 2% HEDTA system at pH 5 gave a separation factor >10^8 and, by suitable operations on the eluted fractions, 70 to 80% of the ^{90}Y content of the starting material was recovered in 5 to 6 hours. (auth)

25198 (Y-1502) MIXING AND SAMPLING ENRICHED ^{235}U FLUID IN CYLINDRICAL STORAGE CYLINDERS. A Progress Report. Harrell, James E. (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). Mar. 8, 1966. Contract W-7405-eng-26. 108p. Dep. mn. CFSTI $4.00 cy, $0.75 mn.

The intermixing of fluid contained in cylindrical safe-geometry tankage, as found in nuclear fuel processing plants handling solutions of fissionable material, was investigated. Utilizing an approximation to pulse-type tracer injection methods, experimental data were collected for four and six-inch-diameter single tank loops, two-in-parallel tank loops, and complex-flow-path tank loops mixed by pump recirculation, and for a six-inch-diameter single vertical tank mixed by air sparging. A defined mixing time (mixing period needed to dispose a tracer pulse to near homogeneity with tank-loop contents) was measured for each type system and found to vary linearly with the recirculation rate when plotted on full logarithmic paper. For single tank loops, mixing time for both completely and partially fill conditions ranged between 10 and 625 minutes for recirculation rates between 1 and 100 gpM. The nature of mixing in parallel-tankage loops was considered by varying the ratio of flow through two identical tanks at aggregate flows between 10 and 100 gpM; an optimum flow split ratio where mixing time is minimized was found to exist at about 0.7. Some of the mixing characteristics for series-parallel flow through a single tank loop were studied; mixing time data for several loop systems were analyzed. In addition, the relationship between dispersion intensity which embodies the effective rate of mixing and Reynolds number was studied for several single tank loops. The relationship was found to be linear when plotted on full logarithmic paper and to deviate significantly at low Reynolds numbers from published data for very long pipelines. Preliminary mixing-time data obtained for the air-sparged tank varied between 11 and 31 minutes at air rates between 0.12 and 5.0 scfm. A theory for the recirculation mixing of fluids contained in cylindrical-tankage loops was developed based on the dispersion model and on the tanks-in-series model. Because either an analog or a digital computer solution is required for each theoretical treatment, only the single-tank-loop theory has yet been tested with experimental data. For this type of loop, when using an experimentally measured dispersion intensity and at Reynolds numbers greater than about 10,000, the predicted mixing times were found to agree within ±30%. (auth)

25199 (ORNL-tr-1121) RESEARCH AND STUDIES RELATIVE TO THE HOT SEMI-PILOT PLANT. Heremans, R.; Broothaerts, J.; Lambiet, C.; Put, M. [Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)]. Translated for Oak Ridge National Lab., Tenn. 19p. Dep. mn. JCL $1.10 fs, $0.80 mf.

Volatilization conditions of Pu in the presence of fissium and alumina were studied for the reprocessing cycle of ceramics ($(U,Pu)O_2$), based on an oxidation-hydrofluorination and on fluorination with ClF_3 and fluorine. The principal difficulty encountered during studies on a laboratory scale was compacting of the powder. Different reagents were used to convert the compacted uranium monocarbide into powder, especially water vapor, CO_2, and an O/HF mixture. The latter was found to be most suitable in order to obtain a complete chemical conversion. A series of experiments demonstrated the high efficiency of the venturi scrubbers with spray nozzles in order to remove the fluorinating agents (HF, F_2, ClF_3, UF_6) prior to the disposal of the gaseous effluents through the absolute filters of the ventilating system. (P.C.H.)

25200 ZIRCONIUM AND HAFNIUM SEPARATION BY LIQUID-LIQUID EXTRACTION. Sinegribova, O. A.; Yagodin, G. A. (Mendeleev Inst. of Chemical Technology, USSR). At. Energy Rev., 4: 93-106(1966).

Extraction techniques are widely used for the separation of zirconium and hafnium and also for studying their chemical characteristics. Zirconium and hafnium pass into the organic phase and together with the extractants form salts or solvate complexes, depending on the composition of the aqueous solution and the extractant used. The chemistry of zirconium and hafnium extraction as performed with acid extractants, amines, and organophosphorous ethers is discussed. Special attention is paid to the extraction of the two elements in the form of thiocyanate complexes. (auth)

25201 THE LABORATORY INVESTIGATION OF SOME FACTORS INFLUENCING THE AQUEOUS DISSOLUTION OF THE URANIUM CONTENTS OF ROCKS. II. Horvath, Eva. ATOMKI (Atommag Kut. Intez.) Kozlem., 7: 221-36(Dec. 1965). (In Hungarian).

It was observed previously that the quantity of U dissolved from rocks in contact with aqueous phases depends only slightly on the granulation (surface of dissolution) of the rock. An attempt was made to prove that a large quantity of the U leached from a large surface is bound to the rock again. Investigations were carried out at nominal U content in the liquid phase between 0.4 and 1500 g/ton. After a preset time had elapsed, the ratio of the quantity of U readhering to the rock to that remaining in the aqueous solution was measured; the curves showing this ratio exhibit the characteristics of adsorption isotherms. The saturation quantity of U adsorbed for each rock type was much higher for rocks of smaller granule size than for those of larger size. The enrichment factor was about 10 times higher for the smaller granule sizes. Consequences of this adsorption effect are discussed. (M.J.T.)

25202 SOME ASPECTS OF FIXATION OF URANIUM FROM NATURAL WATERS. Muto, Tadashi; Hirono, Shuichiro. Kozan Chishitsu, 15: 287-98(Dec. 1965). (In Japanese).

Uranium in natural waters can be fixed either by precipitation of uranium minerals or by adsorption on some adsorbents such as clay minerals and carbonaceous materials. The precipitation is controlled by factors contributing to the conditions of a system from which a uranium mineral is precipitated, such as temperature, pressure, pH, Eh, and concentration of the elements constituting it. Each factor was examined thermochemically. Decrease in Eh is most effective for the formation of primary uranium minerals, while pH and concentration of such anions as those of phosphorus, vanadium, and arsenic play the most important role in the precipitation of secondary uranium minerals. Adsorption and desorption experiments of hexavalent uranium on montmorillonite, kaolin, and limonite reveal that they have more or less an order of 10,000 ml/g of enrichment factor (Kd) at about pH 6. The adsorbed uranium was found to alter to a ura-

nium mineral most favorable for the surrounding condition when aged experimentally. It suggests that the adsorbents perform a kind of catalytic action for the formation of uranium minerals from very dilute solution such as surface waters. (auth)

25203 DEVICE FOR CONTINUOUS MEASUREMENT OF THE EFFLUENT ACTIVITY FROM CHROMATOGRAPHIC COLUMNS. Lis, Stanislaw; Kowalski, Zdzislaw (Instytut Badan Jadrowych, Warsaw). Nukleonika, 10: 733-4(1965). (In Polish).

In order to determine continuously the activity of effluents from chromatographic columns, the liquid flow is directed through a 1-mm dia polyethylene tube, which passes through a lead shield to a G-M counter, and then to a volume-measuring device consisting of a drop counter. A chromatogram is obtained by plotting the count rate from the activity measurements against the total number of drops. A sample chromatogram, representing the separation of Tb, Gd, Eu, and Cs, is shown. (TTT)

25204 EXTRACTION OF Ru AND Zr BY LONG CHAIN AMINES. Shankar, J.; Venkateswarlu, K. S.; Lal, Manohar; Shankar, R. (Atomic Energy Establishment, Trombay, India). pp 11-14 of Proceedings of the Nuclear and Radiation Chemistry Symposium, 1964. Trombay, India, Atomic Energy Establishment, 1965.

Ru and Zr are important fission products, which interfere in the TBP extractions of U and Pu. Studies on the extraction behavior of Ru and Zr from sulfuric acid solutions by three long-chain amines are reported. The efficiency of extraction for Ru(III) is in the order Primene JMT, LA-2, and triisooctylamine. Generally, an excess of sulfate ions inhibits Ru(III) extraction. Several nitrosyl complexes of Ru (III) were also studied for their possible extraction. The extraction of Ru(III) was negligible from HCl solutions in contrast to Fe(III). The behavior of Zr studied as $^{95}Zr/^{95}Nb$ was different from that of Ru. Even at low amine concentrations the extraction from sulfuric acid solution was very high. The nature of the extracting species appeared to be $[ZrO(SO_4)_2]^{-2}$. After extraction, Zr was readily strippable into the aqueous phase with HCl. (auth)

25205 LIQUID ANION EXCHANGE BEHAVIOUR OF Th, Pa AND U. Shankar, J.; Venkateswarlu, K. S.; Subramanyan, V.; Dhaneshwar, Smt. M. R. (Atomic Energy Establishment, Trombay, India). pp 26-9 of Proceedings of the Nuclear and Radiation Chemistry Symposium, 1964. Trombay, India, Atomic Energy Establishment, 1965.

The extraction of Th, Pa, and U from sulfuric acid solutions into Primene JMT, LA-2, and triisooctylamine was studied. The extraction of Pa from chloride solutions is also reported. The parameters investigated include variation of amine concentration, sulfate complexing, synergistic effects, and the behavior of irradiated solvents. Thorium was not extracted from H_2SO_4 solutions by triisooctylamine, but it was readily extractable by Primene JMT. LA-2 was effective only at high amine concentrations. No synergism was observed with mixtures of LA-2 and TIOA. The species of Th present in the organic phase appeared to be $[Th(SO_4)_3]^{-2}$. Protactinium was readily extracted from sulfate as well as chloride solutions. The studies indicated the presence of more than one species. The independent variation of H^+ and Cl^- confirmed the presence of hydroxylated species. Uranyl ions were extracted from sulfuric acid solutions by all the amines studied. The nature of the extracting species appeared to be $UO_2(SO_4)_3^{-4}$, although spectrophotometric evidence indicated the species in the aqueous phase to be $UO_2(SO_4)_2^{-2}$. Mixtures of LA-2 and TIOA exhibited pronounced synergistic effects. The sulfate complexes in the organic phase were readily strippable by chloride solutions. The behavior of γ-irradiated LA-2 was not different from the ordinary solvent. (auth)

25206 COMMERCIAL ASPECTS OF FUEL PROCESSING. Mecham, W. J.; Jonke, A. A. Reactor Fuel Process., 9: 1-15(Winter 1965–1966).

Fuel processing plans, values in spent fuel from power reactors, spent-fuel processing costs for advanced converters, economic evaluation of close-coupled fuel processing, economics of irradiated fuel shipment, and patents concerning processing are discussed. (23 references). (M.C.G.)

25207 RESEARCH AND DEVELOPMENT ON AQUEOUS PROCESSING. Reactor Fuel Process., 9: 16-23(Winter 1965–1966).

Methods for the dissolution of sintered aluminum powder and of high-strength aluminum fuel alloys were studied. Use of U(IV) for reduction of Pu in TBP processing is discussed. Ruthenium decontamination in extraction processes and extraction with amine–ether systems are considered. The separation of americium and curium from irradiated plutonium is described. Plant and equipment design and operation are reviewed. (21 references). (M.C.G.)

25208 RESEARCH AND DEVELOPMENT ON NON-AQUEOUS PROCESSING. Reactor Fuel Process., 9: 24-39 (Winter 1965–1966).

Volatility processes for highly enriched fuels and for fuels of low enrichment are described. Compact pyrochemical processes in the EBR-II fuel cycle facility and processes for advanced reactor fuels are considered. (52 references). (M.C.G.)

25209 SEPARATION ON SILICA GEL OF ^{233}Pa FROM NEUTRON-IRRADIATED THORIUM. Davydov, A. V.; Palei, P. N. Tr. Kom. Anal. Khim., Akad. Nauk SSSR, Inst. Geokhim. Anal. Khim., 15: 368-74(1965). (In Russian).

A method for the separation of ^{233}Pa from neutron-irradiated thorium compounds was developed. It was based on the selective sorption of protactinium on silica gel from 6M HNO_3 solutions with subsequent desorption with solutions of oxalic acid and hydrogen peroxide. (tr-auth)

25210 AMINATED POLYVINYL CHLORIDE: A NEW ANION-EXCHANGE RESIN FOR THE RECOVERY OF URANIUM FROM SILICEOUS LIQUORS. Audsley, A. (National Physical Lab., Teddington, Eng.); Pearson, D.; Wells, R. A.; Beaumont, J. H.; North, A. A. Trans. Inst. Mining Met., 75: C13-C25(1966).

Anion-exchange resins were prepared by the reaction of polyvinyl chloride (PVC) beads with concentrated aqueous solutions of aliphatic primary diamines or, alternatively, polyamines. The capacities of these resins range up to 5.5 milliequivalents (meq.) per gram and depend on the selected amine, its concentration in solution, and the duration and temperature of the reaction. These resins have no strong-base properties but might, nevertheless, be employed in industrial plants for the recovery of uranium from sulfate leach liquors. The PVC-based resins are considered superior to the polystyrene-based resins in some respects; they reject silica more completely and therefore do not exhibit gradual deterioration in ion-exchange properties due to the cumulative retention of silica, and selectivity for uranium in the presence of bisulfate and rare earths is higher. They have the disadvantages of a lower density, which results, under conditions of optimum pH, in lower ion-exchange capacity for uranium per unit volume of resin and a slower rate of elution of uranium by chloride solutions. Thus it is necessary for the same elution efficiency, to use a more concentrated solution of sodium chloride than that normally used for the elution of strong-base polystyrene resins, and the consumption of sodium chloride is increased. The performances of a PVC-based resin and a commercially produced strong-base polystyrene resin, when used continuously for the recovery of uranium, were compared in a pilot-plant test of nineteen days' duration. The pregnant liquor, which was prepared by leaching a low-grade uranium ore with sulfuric acid, contained about 2.5 g SiO_2 per liter. This test showed that the PVC-based resins are suitable for uranium recovery and confirmed the predictions, based on small-scale tests, that the resins do not retain silica to the same extent as the strong-base polystyrene resins now in use. (auth)

25211 COUNTERCURRENT, BOX-TYPE, EXTRACTION APPARATUS. Korpusov, G. V.; Tsylov, Yu. A. Tsvetn. Metal., No. 2, 66-8(1965).

Separation of the rare earth salts is mostly done by extraction. An apparatus was designed which applies the following principles: hydraulic isolation of the sediment from the mixing chamber; hydraulic isolation of neighboring cells, preventing the disruption of steady-state phases during halted operation; suction of both phases through a turbine for better intermixing of the solutions; and adjustment of the interphase level in each cell, assuring operational stability over a wide range of phase density differences. The apparatus is a rectangular box divided by 10 solid partitions into cells. The top of the box is hermetically closed by a lid supporting a motor, which drives the small turbines affixed to the same lid. The bottom is provided with a water jacket permitting heating, if necessary. Each cell consists of a mixing and a sedimentation chamber. The emulsion flows over the partition between these chambers. The heights of both the light-phase and heavy-phase outlet tubes are adjustable. Such devices made of stainless steel or plastic with 15 to 70 cells were tested for 2 years and proved their high efficiency (above 95%). (ATD)

25212 PURIFICATION OF SODIUM DIURANATE AT THE ELDORADO BEAVERLODGE MILL. Ritcey, G. M.; Joe, E. G.; Hawtrey, R. C. 24p. (CONF-651019-3). ORAU. Gmelin, AED-CONF-65-294-5.

From 15th Canadian Chemical Engineering Conference, Quebec City.

Sodium diuranate is produced at Eldorado's Beaverlodge mill by caustic precipitation of the uranium-bearing sodium carbonate leach liquor. Carbonate and vanadium impurities must be removed to make the product salable. Conditions established for impurity removal were: calcination of the precipitate at 700°C nominal, air atmosphere, and water leaching and acid precipitation of the leach liquor for vanadium recovery. Following pilot plant experimentation, the calciner unit selected was a vertical ten-hearth type, constructed of Inconel with twin electrically heated silicon carbide resistance bars in each compartment. The unit, built by Canadian Locomotive Company, was installed and operated successfully at Beaverlodge. (auth)

25213 BERYLLIUM ORE EXTRACTION PROCESS. Bach, Ricardo Otto (to Beryllium Metal and Chemical Corp.). British Patent 1,023,357. Mar. 23, 1966. Filed Aug. 23, 1963.

A method is described for the production of $BeCl_2$ from beryllium ores with the subsequent reduction of the $BeCl_2$ to Be metal. An oxidic compound of Be is powdered so that substantially all of it is finer than 100 mesh. The powdered oxidic ore is reacted with $SiCl_4$ or $BeCl_3$ in the presence of an oxide, halide, or carbonate of an alkali metal and/or an alkaline earth metal other than Be at temperatures of from 1000 to 1550°C. The resulting $BeCl_2$ is isolated in the gaseous form before reduction to Be metal. (B.L.M.)

25214 METHOD OF EXTRACTION OF METALS BY FUSION ELECTROLYSIS. (to Elektrophysikalische Anstalt Bernhard Berghaus). British Patent 1,023,522. Mar. 23, 1966. Priority date Dec. 16, 1961, Switzerland.

A method is patented for the production of a metal of the group Mg, Be, Al, Ti, Zr, and Hf by fusion electrolysis of an electrolyte. The electrolyte is maintained at a temperature below the melting point of the metal to be produced. The anode consists at least partly of the metal to be obtained. The electrolyte consists of an alkali metal halide, the halide of the metal, and at least 10% by weight of the oxide of the metal. This oxide is obtained by heating the corresponding hydroxide at temperatures below 900°C, preferably between 500 and 700°C. A catalyst composed of a compound of the metal to be obtained with a halogen and with one or more other non-metal, preferably H_2 and N_2 is added to the electrolyte. (B.L.M.)

25215 METHOD FOR THE EXTRACTION OF URANIUM FROM A DILUTE SOLUTION CONTAINING THE URANIUM IN THE FORM OF THE ANIONIC COMPLEX $[U_2(CO_3)_3]$ 4-. Pottier, Paul; Macchiaverna, Edmondo (to Commissariat a l'Energie Atomique. Comision Nacional de Energia Atomica Argentina). German Patent 1,209,114. Jan. 20, 1966. Priority date June 11, 1963, France.

The method comprises the steps of fixing the uranium on a basic exchange resin and of eluting with an aqueous solution containing an alkaline bicarbonate and ammonium carbonate. The uranium is precipitated in the form of $(NH_4)_4[UO_2(CO_3)_3]$. The solution obtained, after the carbonate content is standardized, is recirculated into the elution. (Gmelin Inst.)

25216 METHOD FOR REPROCESSING OF IRRADIATED NUCLEAR FUEL. Vogg, Hubert; Baehr, Werner (to Gesellschaft fuer Kernforschung mbH). German Patent 1,209,564. Jan. 27, 1966. Filed Aug. 8, 1964.

The method previously developed was improved. The precipitate obtained during decomposition of the fuel with an oxidizing alkali melt was separated by filtering the still liquid melt. The solidified material was leached out. (Gmelin Inst.)

25217 METHOD FOR THE SEPARATION OF NUCLEAR FUEL MATERIALS. Vogg, Hubert; Baehr, Werner (to Gesellschaft fuer Kernforschung mbH). German Patent 1,209,745. Jan. 27, 1966. Filed Aug. 8, 1964.

The method for the separation of nuclear fuel (U from Pu or Th) is described, which employs the digestion of the fuel in an alkaline melt. This method was improved by maintaining the alkalinity of the melt at a predetermined value during the digestion process. (Gmelin Inst.)

25218 RECOVERY OF URANIUM AND PLUTONIUM VALUES FROM AQUEOUS SOLUTIONS OF AMMONIUM FLUORIDE. Gens, T. A. (to U. S. Atomic Energy Commission). U. S. Patent 3,238,014. Mar. 1, 1966.

A process was developed for recovering uranium from an aqueous ammonium fluoride solution containing uranium and zirconium at a pH of ~6. A soluble peroxide is added to the solution. Uranium precipitates almost completely as an insoluble peroxide prior to any zirconium precipitation. (AEC)

25219 SELENIUM RECOVERY FROM URANIUM LEACH LIQUOR. Reusser, Robert E.; Hart, James L. (to Phillips Petroleum Co.). U. S. Patent 3,239,306. Mar. 8, 1966. Filed July 26, 1962.

A process is described for recovering U and Se values from an ore. An aqueous slurry of the comminuted ore is oxidized in the presence of a carbonate leaching solution to form a pregnant liquor containing dissolved water soluble U compounds and selenium compounds. The undissolved solids are separated, and the dissolved values in the pregnant liquor are treated with a sulfide containing compound to precipitate the Se and with NaOH to precipitate the U in the form of yellow cake. The resulting barren solution is separated from the precipitated values, and the precipitated values are heated at elevated temperatures to form the volatile SeO_2 leaving the insoluble U values. If V is present in the pregnant liquor, it is precipitated along with the U and Se values. The combined precipitated values are treated with an aqueous solution containing Na^+ present in an amount ranging from 5 to 15 wt % based on the precipitated U values, and the resulting slurry is heated at elevated temperatures to convert the Se values to sodium selenate and the V values to sodium vanadate. The heated product is quenched with water to dissolve the Se and V compounds and leave the U values in insoluble form. The V values are separated from the Se by extraction with a quaternary amine-hydrocarbon mixture, and acidification and reduction with SO_2 of the solution remaining after extraction reduces the Se values to insoluble form. (B.L.M.)

25220 REMOVAL OF SELENIUM FROM URANIUM LEACH LIQUORS. Reusser, Robert E. (to Phillips

Petroleum Co.). U. S. Patent 3,239,307. Mar. 8, 1966. Filed July 26, 1962.

A process for recovering U and Se values from an ore comprises oxidizing an aqueous slurry in the presence of carbonate and bicarbonate to yield a pregnant leach liquor containing water soluble uranium and selenium compounds, separating the undissolved solids, and recovering the soluble U and Se values. The pregnant liquor is treated with Al to form insoluble U values and soluble Se values, and the insoluble U values are recovered. The pregnant liquor is then oxidized to recover the Se in elemental form, and the barren solution is recycled to the leaching circuit of the process. Alternatively, the pregnant liquor containing both U and Se values may be treated with an agent selected from the group consisting of Na_2S, H_2S, $Na_2S_2O_3$, Na_2SO_3, and $Na_2S_2O_4$ to form insoluble elemental Se which is separated from the resulting slurry in a filtration zone. The U values are then recovered from the pregnant liquor. (B.L.M.)

25221 RECOVERY OF URANIUM VALUES BY SOLVENT EXTRACTION. Henrickson, Angus V. (to Kerr-McGee Oil Industries, Inc.). U. S. Patent 3,241,909. Mar. 22, 1966. Filed Dec. 13, 1962.

A method is described for the recovery of U values from aqueous sulfate leach liquors in which the leach liquor is intimately contacted with a solution of a substantially water-insoluble weak base organic amine solvent extractant for U to absorb the U values and produce a U-loaded extractant. The extractant is dissolved in a substantially water-insoluble organic diluent; and after extraction of the U, the organic extractant is contacted with an aqueous suspension consisting essentially of water and a finely divided magnesium containing compound, preferably the oxide or hydroxide, in an amount sufficient to strip the U values from the organic phase and produce an aqueous solution containing dissolved U values. The phases are separated, and the U concentrate is precipitated from the separated aqueous medium by the addition of a basic substance. The U extractant is an alkyl substituted amine selected from the group consisting of tri-n-alkyl amines, dialkyl amines, and mono-n-alkyl amines in which the alkyl group contains not more than 30 carbon atoms per alkyl group and at least 6 carbon atoms when the amine is a tri-n-alkyl amine, 8 when it is a dialkyl amine, and 18 when it is a mono-n-alkyl amine. (B.L.M.)

25222 RECOVERY OF URANIUM AND ZIRCONIUM FROM AQUEOUS FLUORIDE SOLUTIONS. Coleman, C. F. (to U. S. Atomic Energy Commission). U. S. Patent 3,243,257. Mar. 29, 1966.

A process for recovery of uranium values from an aqueous fluoride solution is described. The free fluoride concentration of the solution is adjusted to ~1M F^- and the solution contacted with an organic mixture comprised of a substantially water-immiscible diluent, a dialkylphosphate with a total number of carbon atoms of at least ten, and a neutral organophosphorus compound. The alkyl and alkoxy radicals of this neutral compound should have at least one substituent selected from the group consisting of hydroxyl and chloro. The total number of carbon atoms in the neutral organophosphorus compound should be at least ten. Uranium values are transferred to the organic phase and the resultant uranium-enriched organic phase is separated from the contacted aqueous phase. (AEC)

25223 SOLVENT EXTRACTION PROCESS FOR SEPARATING RHENIUM FROM MOLYBDENUM. Churchward, Philip E. (to Dept. of Interior). U. S. Patent 3,244,475. Apr. 5, 1966. Filed Oct. 31, 1962.

A solvent extraction process for separating Re from Mo in aqueous solutions that originate from the leaching of Mo waste flue dust or from scrubbing of the off-gas from a molybdenite roaster. An oxidizing agent is added to the aqueous solutions to convert the Mo to the hexavalent state and the Re to the heptavalent state (perrhenate) and the pH of the solutions is neutralized to 10 to 12. The solution is contacted with an organic extractant containing a quaternary ammonium compound having the formula $R_3(CH_3)NCl$ in which R is a saturated straight-chain alkyl radical of from 8 to 10 C atoms and is contained in an organic solvent that is immiscible in water. The Re values are transferred from the aqueous to the organic phase by contacting the two phases while the Mo values remain in the aqueous phase. The Re values are stripped from the organic phase with perchloric acid, a soluble perchlorate, or concentrated hydrochloric acid. The preferred quaternary ammonia compound is tricapryl methyl ammonium chloride, available commercially under the name Aliquat 336; and the preferred organic solvent is kerosene, but tributyl phosphate and a higher alcohol can be used. (B.L.M.)

25224 METHOD FOR PROCESSING ALUMINUM-CONTAINING NUCLEAR FUELS. Guthrie, C. E. (to U. S. Atomic Energy Commission). U. S. Patent 3,251,645. May 17, 1966.

A nonaqueous method for processing aluminum-containing nuclear fuels is described. The fuels are dissolved in a molten salt mixture of substantially $67KF\text{-}21ZrF_4\text{-}12AlF_3$ while passing anhydrous hydrogen fluoride through the melt and while maintaining the melt temperature below about 600°C. When the AlF_3 concentration reaches about 32 mole % and without exceeding a melt temperature of about 600°C, fluorine gas is passed through the melt to convert the dissolved fuel values to the volatile hexafluoride and thereafter a portion of the melt is discarded and KF and $2KF \cdot ZrF_4$ salts added to the remaining salt melt to return the salt composition back to the initial composition of substantially $67KF\text{-}21ZrF_4\text{-}12AlF_3$. (Gmelin Inst.)

ENGINEERING

General

Refer also to abstract 26525.

25225 (N-65-35969) DEVELOPMENT OF ELECTRIC SWITCHGEAR FOR SPACE NUCLEAR ELECTRICAL SYSTEMS. Quarterly Progress Report No. 3, June 4–September 4, 1965. Powell, A. H. (ed.) (General Electric Co., Cincinnati, Ohio. Space Power and Propulsion Section). Contract NAS3-6467. 48p. (NASA-CR-54743). CFSTI $2.00 cy, $0.50 mn.

Continued research conducted under a program designed to provide data from which final flight hardware for planned nuclear space power systems of 1- to 4-Mw capacity could be developed is reported. Development effort will result in building and testing ground prototype breakers (600 amp and 1000 v) and contractors (10,000 v d-c) which can withstand launch environment (mechanical) conditions, as well as expected space conditions including low pressure, high temperature, and radiation. The devices are also able to successfully interrupt short circuits of twice normal current ratings. All details for making the sample breakers and contactors were completed, most of the required raw material was obtained, and plans for fabrication and assembly were initiated. Parts of both the vacuum interrupters and the actuators were investigated. Proposed construction and assembly methods were checked, and improved latch and trip mechanisms were created and were included in the final design. Designs were frozen, and all detail and assembly drawings were issued. A sketch of the complete breaker is included. Raw material is being reviewed to determine the most favorable processor. Test specifications are being prepared, and the assemblage of high vacuum oven equipment for the first tests (heat run) initiated. Data on expected milestone dates were also compiled. (STAR)

25226 EXPLOSIVE DRIVEN SHOCK TUBES. **Duff, Russell E. (Univ. of California, Livermore); Blackwell, Arlyn N. Rev. Sci. Instrum., 37: 579-86(May 1966). (UCRL-12428).**

Several different explosive-driven shock tubes were developed as sources of short-duration, supersonic, high-pressure pulses which can be used to load large, massive objects with accelerations up to many thousand g's. These shock tubes are particularly appropriate for simulating strong blast effects on hardened structures. An important characteristic of these shock tubes is the use of detonation products as the primary working fluid. Therefore, this represents one of the few instances in which the "cold flow" of a shock tube has been used for aerodynamic testing. Extensive design calculations are presented; experimental measurements in a number of configurations are in good agreement with the calculations. The facilities tested have produced peak dynamic pressures of 70 to 2,000 bar for half-time durations from a few hundred microseconds to several milliseconds. Tube diameters varied from 0.6 to 2 m, and the lengths ranged between 3 and 15 m. (auth)

25227 A RADIOACTIVE KRYPTON DIFFUSION TECHNIQUE FOR TEMPERATURE MAPPING OF TURBINE BLADE SURFACES. **Wisnieff, Stanley F.; Bardach, Herbert. New York, Society of Automotive Engineers, Inc., 1965, Preprint No. 650704, 6p. (CONF-651048-1). ORAU.**

From Society of Automotive Engineers, Combined Powerplant and Transportation Meeting, Cleveland.

Development of turbine blade cooling techniques has been prompted by the demand for increased power and efficiency from existing engine envelopes. Accurate determination of temperature profiles exhibited by the turbine blades during engine operation expedite the attainment of optimum design. The use of radioactive krypton-85 to determine the maximum temperature experienced by the blade surface during the engine operating period is described. Apparatus and procedures developed and typical temperature evaluations are presented. (auth)

25228 NUCLEAR ENGINEERING. PART XII. **Rutledge, Gene P. (ed.). Chem. Eng. Progr., 61: Symp. Ser. No. 60, 1-185(1965). (CONF-242).**

Separate abstracts were prepared for 16 of the 17 included papers. The remaining paper gives background information of the Nuclear Safety Guide, TID-7016. (L.B.S.)

For abstracts of individual papers see: 25229, 25253–25259, 25325, 26398, 26430–26434, and 26448.

25229 NUCLEAR SAFETY AND THE CHEMICAL ENGINEER. **Paxton, Hugh C. (Los Alamos Scientific Lab., N. Mex.). Chem. Eng. Progr., 61: Symp. Ser. No. 60, 1-8 (1965).**

The field of nuclear safety has become organized sufficiently for consideration as an engineering discipline. Responsibilities of the chemical engineer who is concerned with nuclear fuel can be fulfilled more satisfactorily if he accepts this discipline. Further incentive is illustrated by striking technological developments that involve the interplay of process and criticality control requirements. (auth)

Applications of Nuclear Explosions

25230 (HN-183) STRUCTURAL AND SHIELDING CONSIDERATIONS IN THE DESIGN OF HARDENED FACILITIES. **Karcher, R. H.; Wilson, J. H. (Holmes and Narver, Inc., Los Angeles, Calif.). June 30, 1965. Contract W-7405-eng-26, Subcontract 2461. 178p. (AD-479254). Dep. mn. CFSTI $5.00 cy, $1.00 mn.**

For Oak Ridge National Lab., Tenn.

Structural requirements and initial radiation shielding requirements were calculated as a function of weapon yield and separation distance for fully buried domes, arches, and rectangular structures. The two criteria were superimposed to determine the range and magnitude of the shielding problems attendant to the design of hardened structures. The single-degree-of-freedom spring-mass system was used to describe the response of structures to blast loading. Neutron penetration of structures were calculated by means of removal-diffusion theory while gamma penetration was calculated using point kernel techniques. The interaction of structural and shielding criteria were analyzed in considerable detail and initial radiation shield requirements were given as a function of weapon yield for a number of discrete overpressure levels. (auth)

25231 (PNE-504F) STRONG-MOTION SEISMIC MEASUREMENTS. Final Report, Project Pre-SCHOONER, Nevada Test Site, February, 1964. **Cauthen, Lewis J. Jr. (Lawrence Radiation Lab., Univ. of California, Livermore). Sept. 1965. Contract W-7405-eng-48. 31p. Dep. mn. CFSTI $0.55 cy, $0.50 mn.**

Strong motion seismograph stations were operated by the U. S. Coast and Geodetic Survey during the four Pre-Schooner cratering experiments conducted in basalt on Buckboard Mesa at the Nevada Test Site. The purpose of the strong motion experiment was to study the ground shock resulting from small-scale cratering detonations in hard rock. Surface acceleration and displacement time histories were recorded for each detonation at selected instrument stations. The results indicate that the ground shock resulting from the Pre-Schooner detonations (20-ton high explosive cratering detonations) differed from that observed from larger yield nuclear explosions. The

most significant difference was in the attenuation rate of the surface acceleration which was higher for the Pre-Schooner detonations than has generally been observed for nuclear detonations. Also, surface displacements for the Pre-Schooner detonations were higher than would be predicted from previous nuclear surface displacements. (auth)

25232 (PNE-701F) TOTAL CLOUD ACTIVITY MEASUREMENTS. Project SULKY. Gaines, Jerry L. (Lawrence Radiation Lab., Univ. of California, Livermore). May 18, 1965. Contract W-7405-eng-48. 34p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Gamma radiation detectors in three fixed ground stations and in a helicopter were used in an attempt to measure the total radioactivity as a function of time for the dust cloud produced by the Sulky event. Large plastic scintillators, photomultiplier tubes, and crudely collimated lead shields were the basic components of the detectors. A constant-current, variable-voltage regulator circuit enabled the detectors to operate in very high as well as in low radiation fields. Because the Sulky event did not crater as expected, there was no large radioactive dust cloud for the detectors to observe. Instead a small dust cloud of relatively low activity was produced, followed immediately by a continuous stream of much more radioactive gas which flowed from the resulting pile of rubble for a considerable length of time. (auth)

25233 THE USE OF NUCLEAR EXPLOSIVES IN ENGINEERING AND INDUSTRY. Johnson, G. W.; Higgins, G. H. (Univ. of California, Berkeley). J. Brit. Nucl. Energy Soc., 5: 60-71(Jan. 1966). (UCRL-14314).

A single hydrogen bomb with a total volume no greater than a bulldozer can move more dirt in seconds than the bulldozer can in months and at a 1/100th the cost. To harness this explosive power for peaceful applications has been the aim of the Plowshare Program, established in 1957 under the directorship of G. W. Johnson. Because of early interest by the Panama Canal Company in the possible excavation of a sea level canal, the development program has been concerned with reducing radioactivity in fallout to a minimum, and developing cratering technology. Concurrently, numerous studies of underground mining applications were carried out and the general understanding of underground nuclear explosions was expanded. The present state of knowledge of nuclear explosions in various environments for both deeply buried, contained explosions, and for less deeply emplaced charges which result in craters is described. (auth)

25234 PROJECT GASBUGGY A NUCLEAR FRACTURING EXPERIMENT. Ward, Don C. (Bureau of Mines, Bartlesville, Okla.); Atkinson, Charles H.; Watkins, J. Wade. Dallas, Society of Petroleum Engineers of AIME, 1965, Preprint No. SPE 1273, 16p. (CONF-651007-2). ORAU.

From Society of Petroleum Engineers, 40th Annual Fall Meeting, Denver.

The experiment is designed for the detonation of a 10-kt fission explosive at a depth of 4,150 ft to evaluate the stimulative effect on gas production from the Pictured Cliffs formation in the San Juan Basin, New Mex. This contained nuclear detonation will create a collapse chimney which, together with a zone of highly fractured rock beyond the chimney, comprises an expansive permeable volume—the extent of which, in this low-permeability reservoir, may be considered an exceedingly large, effective wellbore, resulting in increased gas flow. Flow calculations, based on the predicted extent of effective fracturing, indicate that gas recovery will be increased by a factor of at least seven over that obtainable by the present stimulative method—selective perforating and, hydraulic fracturing. The true stimulative effectiveness will be evaluated by measurements made in existing and newly drilled wells at various distances from the detonation. Also, the determination of the extent that radioactive contamination is a production problem, and investigation of methods of handling the produced fluids are integral parts of the experiment. The experiment can be conducted so that neither radioactive contamination nor ground shock would be hazardous. Nuclear-explosive stimulation of natural gas reservoirs is technically feasible, but only from analysis of production data obtained by this and future experiments can the economics be determined. (auth)

Facilities and Equipment

25235 STATIONARY OPERATIONAL BEHAVIOR OF GAS TURBINES DRIVEN BY CONVENTIONAL AND NUCLEAR ENERGY. Bammert, K.; Twardziok, W. (Technische Hochschule, Hanover). Atomkernenergie, 11: 185-204(May-June 1966). (In German).

A method was developed that permits calculation of the behavior in stationary operation of closed-cycle gas turbines of any design. Equations are stated, which describe the behavior of the individual units, turbine, compressor, heat exchanger, cooler, and heater. The calculated characteristics of the individual units were verified by measurements. On the basis of individual performance graphs a complete installation was calculated with various modes of control. Calculation results were compared with part-load measurings of a closed-cycle air turbine plant and the resulting values were virtually the same. As an example for application of the calculating method, the influence of altered individual graphs on the behavior of the complete installation was examined. The behavior of nuclear-power installations with gas-cooled high-temperature reactors, and closed-cycle gas turbines under part-load conditions was calculated. The advantages and disadvantages of various designs for operation with constant output speed are stated and explained. To what extent the various types can be applied without passing the limits set by certain safety requirements (e.g., regarding the surge limit of the compressor) was examined. Graphs of single-shaft and two-shaft nuclear power installations with variable output speed were calculated. As an example, the application as a ship propulsion unit with a variable-pitch propeller was examined and the most economical operation at various modes of control determined. (auth)

25236 GENERATION OF MIXED RAYS. Gruenewald, Theo (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe, Ger.). Atomkernenergie, 11: 259-61 (May-June 1966). (In German).

The dose distribution in a sample can be changed and adapted to a given shape by changing the energy of the radiations forming a mixed radiation. Some resting or rotating targets with slits for electron accelerators and filters with slits for x-ray generators used to generate mixed radiations are described. The possibilities of generating mixed radiations by using radionuclides are discussed. (auth)

25237 DOWNDRAFT TABLE FOR HANDLING HIGH RADIOTOXICITY ALPHA EMITTERS. Denham, Dale H.; Curtis, J. Richard (Univ. of California, Livermore). Health Phys., 12: 712-15(May 1966).

A downdraft table facility was designed to provide capacity for precise manipulation of parts that contain highly radiotoxic alpha-emitting materials. The facility consists of a personnel lock entrance, an intermediate change room, and a specially constructed stainless steel room that houses the downdraft table. A ventilation system designed to provide a minimum capture velocity of 200 ft/min at any point 24 in. above the table surface and protective clothing and traffic patterns comprise contamination control measures. Operating experience was good during the first year. Smear surveys indicate that no detectable activity exists on the floor and horizontal surfaces of the facility. However a portable alpha survey meter indicated levels greater than 10^6 dpm per probe area over the same surfaces. The discrepancy is explained. (H.G.D.)

25238 FLANGED JOINT. (to Aktiebolaget Atomenergi). British Patent 1,024,767. Apr. 6, 1966. Priority date Feb. 1, 1962, Sweden.

A flanged joint is provided that is particularly suitable for reactor pressure vessels and that is substantially free from stressing caused by either the forces keeping the parts of the joint together or by the large internal pressure or temperature differences that may occur between the different parts of the joints and the pressure vessel. Each part of the flanged joint has a flange with a contact surface for effecting an area of sealing contact with each other. Each flange is provided with a set of thrust members abutting on the periphery of the flanges. A first set of tension members extend obliquely from the first flange to the second set of thrust members, and a second set of tension members extend obliquely from the second flange to the first set of thrust members. Spacing members are provided between the thrust members of each set. (B.L.M.)

25239 IMPROVEMENTS RELATING TO GAMMA-RAY APPARATUS. Fulker, George Robert (to TEM Instruments Ltd.). British Patent 1,027,078. Apr. 20, 1966. Filed Feb. 27, 1964.

A gamma ray apparatus is described that is primarily applicable to apparatus intended for therapeutic use but is also applicable to apparatus intended for industrial use, such as for the radiographic examination of structures, welds, and the like. The source container has an array of non-linear passages extending in a common direction in radiation-attenuating material. Each passage of the array is adapted to receive an individual radioactive source unit for storage at a location in the passage so as to maintain the radiation emission from any point on the surface of the container at a value below the maximum permitted. Drive means are provided for selective coupling to an individual source unit housed within the container and movable so as to propel the source unit to which the means are coupled along the passage to its exit. (B.L.M.)

25240 HIGH TEMPERATURE FURNACE. McGuire, Joseph C.; Bowdish, D. D. (to U. S. Atomic Energy Commission). U. S. Patent 3,238,288. Mar. 1, 1966.

A high-temperature inductive furnace utilizing a tungsten tube enclosed within a quartz envelope is described. The tungsten tube is separated and supported from the quartz envelope by thoria insulation. (AEC)

Heat Transfer and Fluid Flow

See also PHYSICS — Fluid Physics and Thermodynamics

Refer also to abstracts 26403 and 26404.

25241 (GEAP–5093) PHYSICAL MODEL OF HEAT TRANSFER BEYOND THE CRITICAL HEAT FLUX. Quinn, E. P. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). Jan. 1966. Contract AT(04-3)-189. 41p. (EURAEC–1603). Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Work Performed under United States–Euratom Joint Research and Development Program.

A physical model of fully-developed film boiling, space-dependent film boiling, and transition boiling for high-pressure forced water flow is analyzed and compared to experimental measurements. An analytical expression is given for the heat transfer from the wall to superheated steam phase in film boiling. Empirical coefficients are shown for the heat transfer between the steam phase and entrained droplets. A relation is given for estimating overall heat transfer coefficients for fully-developed film boiling. Spatially-dependent film boiling is examined and found to be a result of boundary layer and bulk steam phase superheat development. (auth)

25242 (GEAP–5094) PHOTOGRAPHY OF HEATED SURFACE FLUID BEHAVIOR FOR TRANSITION BOILING AT 1000 psia. Swan, C. L. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). Jan. 1966. Contract AT(04-3)-189. 34p. (EURAEC–1606). Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Work Performed under United States–Euratom Joint Research and Development Program.

Selected motion picture frames are presented to illustrate the forced flow fluid behavior on a single-rod heated surface during the critical heat flux, transition boiling, and film boiling conditions at 1000 psia. A sequence in which the heated surface is visible by self-incandescence, in the transition boiling region, is also presented. The heated surface fluid behavior, although not visible, may be inferred from the development of incandescent patches during the cyclic heating and cooling. Both a smooth and finned heated surface were tested. Although improved heat transfer conditions prevailed for the finned surface, no visible differences of the surface fluid behavior were noted. Evidence was obtained to support the view that the critical heat flux occurs by separation and subsequent break-up of a liquid film from the heated surface. (auth)

25243 (INR–658/IX/R) WYMIANA CIEPLA NA POWIERZCHNI KULI W ZLOZU Z KUL. (Heat Transfer on the Surface of a Sphere in the Fixed Bed). Wierusz, A. (Institute of Nuclear Research, Warsaw (Poland)). Sept. 1965. 116p. Dep.

The local processes in a gas cooled spheres bed are described. The thermal boundary layer equation valid for a region of spheres surface where the laminar boundary layer exists, is presented. The numerical solution of this equation is possible thanks to experimental measurements of the velocity field around a sphere in the bed. The solution is used for the determination of the local values of Nusselt numbers. (auth)

25244 (N–65-35248) A SIMPLE EQUATION FOR CORRELATING TURBULENT HEAT TRANSFER TO A GAS. Simoneau, R. J.; Hendricks R. C. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). 1964. 23p. (NASA-TM–X-52011). CFSTI $1.00 cy, $0.50 mn.

Many investigators have employed the conventional Dittus-Boelter (Nusselt type) equation modified by a wall to bulk temperature ratio to correlate turbulent heat transfer data for gases flowing through heated tubes. It was found that the reported convective data for hydrogen, helium, air, and carbon dioxide can be correlated to the same accuracy as the Nusselt type correlations by use of the equation $h = K(pV)_b^{0.8} d^{-0.2} \sqrt{T_b/t_w}$ where K is a constant for any given gas. This equation suggests that for the four gases investigated, a convective correlation for a given gas need not include the temperature dependence of the thermal and transport properties. Based on the plots of these reported data, the values of K are: for hydrogen; 0.0480; for helium; 0.0200; for air; 00420; and for carbon dioxide, 0.00385. These data covered the conditions of film temperature from 500° to 3400°R with wall to bulk temperature ratios from 1.1 to 9.9 No appreciable dissociation was reported in the data. The minimum bulk temperature was 150° above the critical temperature. The bulk Reynolds number ranged from 5000 to 1,500,000 with heat fluxes up to 3 Btu per second per square inch. Tube diameters varied from $\frac{1}{8}$ to $\frac{1}{2}$ inch. (STAR)

25245 (NP–16038) CHOKED-FLOW ANALOGY FOR VERY LOW-QUALITY TWO-PHASE FLOWS. Technical Report No. 18. Hammitt, Frederick G.; Robinson, M. John (Michigan Univ., Ann Arbor. Lab. for Fluid Flow and Heat Transport Phenomena). Mar. 1966. 40p.

Two theoretical models were used to predict axial pressure distribution, void fraction, and velocity in a cavitating venturi. The theoretical predictions were compared with experimental data from cold water and mercury tests, and good agreement for the pressure profiles was found. The predicted void fractions were found to be too high, probably because the models assume zero slip or negative slip between the vapor and liquid phases. The analogy between the cavitating venturi and other choked flow regimes was explored.. One of the theoretical models used is based on the assumption that the cavitating venturi is essentially entirely analogous to a deLaval nozzle operating in a choked flow regime with a compressible gas.

The cavitating venturi is an example of an extremely low quality choked two-phase flow device. Thus, the study is somewhat applicable to the study of liquid-cooled nuclear reactor pressure vessel or piping ruptures. However, the qualities encountered in the present cavitation case are an order of magnitude lower than those usually considered for the reactor safety analyses, so that this study is a limiting case for these. (auth)

25246 (TRG-Inf. Ser–518) BIBLIOGRAPHY ON CAVITATION IN FLUIDS. Chadwick, U. R. M. (Reactor Group, United Kingdom Atomic Energy Authority, Risley (England)). Feb. 1966. 22p. Dep. BIS $0.70. HMSO 3s. 6d.

A listing of 231 articles on cavitation in fluids is presented. The bibliography covers cavitation in various fluids and experimental facilities. (M.O.W.)

25247 (AECL–2330, pp 90–109) ON THE CHANGE IN CERTAIN THERMOPHYSICAL PROPERTIES OF MONO-ISOPROPYLDIPHENYL AND HYDROTERPHENYL DURING RADIOLYSIS. Aleksenko, Yu. N.; Vasil'ev, E. N.; Rokhlova, L. P.; Khramchenkov, V. A.; Yaroslavtsev, B. E. Translated from pp 78–94 of Issledovaniya po Primeneniyu Organicheskikh Teplonositelei-Zamedlitelei v Energeticheskikh Reaktorakh, Atomizdat, Moscow, 1964.

The dependence of the thermophysical characteristics on radiolysis was investigated for products in which this process is accompanied by the simultaneous formation of low-boiling compounds. Hydroterphenyl and monoisopropylbiphenyl were tested for kinematic viscosity and density after being subjected to different radiation doses under different temperature conditions. The change in specific heat for specimens of monoisopropylbiphenyl was also determined. The specimens were irradiated in both aluminum and quartz ampoules and in loop plants at between 30 and 80 Mrad/hr. The monoisopropylbiphenyl specimens were irradiated at 370 to 380°C. The results of measurements show that for temperatures over 100°C, the dependence of the viscosity of monoisopropylbiphenyl on a 0 to 25% content of high-boiling products and a 200 to 300°C radiolysis temperature can be determined within ±20%. The density of monoisopropylbiphenyl was measured at 20 to 220°C on specimens containing 5, 13.45, 24.75, and 39.75% high-boiling products. The viscosity of hydroterphenyl was measured after irradiation at 50°C and its relative viscosity was also determined at 20°C as a function of the high-boiling content. The density of hydroterphenyl subjected to radiolysis in a loop plant at 350°C was also determined. It is concluded that, in order to use hydroterphenyl in a nuclear plant, the operating conditions should be selected so that radiolysis of the heat-transfer agent does not impair its heat-transfer characteristics. (ATD)

25248 (AECL–2330, pp 110–23) INVESTIGATION OF HEAT TRANSFER TO ORGANIC LIQUIDS. Sterman, L. S.; Petukov, V. V. Translated from pp 95–106 of Issledovaniya po Primeneniyu Organicheskikh Teplonositelei-Zamedlitelei v Energeticheskikh Reaktorakh, Atomizdat, Moscow, 1964.

The heat-transfer coefficients to monoisopropylbiphenyl and biphenyl during variations in the process parameters were determined, and the results were compared with theoretical equations of different types. These coefficients were determined during turbulent flow in tubes without a change in the state of aggregation of the organic fluids. The heat-transfer coefficients to monoisopropylbiphenyl were determined at heat fluxes of 200,000, 500,000, and 860,000 kcal/m^2·hr and at circulation rates of 4, 6, 10, and 15 m/sec, and those to biphenyl were determined at a heat flux of 300,000 kcal/m^2·hr and circulation rates of 4 and 6 m/sec. Under these conditions, the Reynolds number was found to fall within 25,000 to 420,000, and the heat-transfer coefficient varied from 3,000 to 18,000 kcal/m^2·hr·°C. (ATD)

25249 (AECL–2330, pp 124–46) DETERMINATION OF CRITICAL HEAT FLUXES DURING BOILING IN PIPES OF HIGH BOILING ORGANIC COOLANTS. Sterman, L. S.; Mikhailov, V. D.; Vilemas, Yu.; Loginov, A. A.; Abramov, A. I. Translated from pp 107–24 of Issledovaniya po Primeneniyu Organicheskikh Teplonositelei-Zamedlitelei v Energeticheskikh Reaktorakh, Atomizdat, Moscow, 1964.

Critical heat fluxes were investigated during the surface boiling of high-temperature organic heat-transfer agents [monoisopropylbiphenyl, a mixture of biphenyl (26.5%) and biphenyl oxide (73.5%), and biphenyl] in a tube. All the tests were conducted in a tube having a 10-mm inner diameter and a wall 1.5 mm thick. Experimental values of q_{crit} were obtained for monoisopropylbiphenyl and circulation rates of 4 and 8 m/sec with a saturation temperature from 0 to 194°C. The tests on the mixture of biphenyl and biphenyl oxide were conducted at pressures of 1, 3, 5, and 10 atm and circulation rates of 5–15 m/sec with a temperature of 0 to 160°C. It is pointed out that none of the existing formulas can be used to determine q_{crit} during surface boiling of these fluids. An equation was derived for determining q_{crit} for volume and surface boiling under conditions of forced motion of a medium. (ATD)

25250 (AECL–2330, pp 147–52) INVESTIGATION OF THE CRITICAL HEAT LOADS DURING SURFACE BOILING OF MONO-ISOPROPYLDIPHENYL IN AN ANNULAR CHANNEL. Mikhailov, L. E.; Naboichenko, K. V. Translated from pp 125–9 of Issledovaniya po Primeneniyu Organicheskikh Teplonositelei-Zamedlitelei v Energeticheskikh Reaktorakh, Atomizdat, Moscow, 1964.

The boiling crisis of the organic transfer agent monoisopropylbiphenyl during forced flow in an annular channel was investigated experimentally. All the elements of the closed-circulation loop were made of 1Kh18N9T stainless steel. The tests were carried out at pressures of 2, 5, and 9 atm, liquid velocities of 2, 4, and 8 m/sec, and a liquid temperature of 100 to 300°C. In addition to the flow of fluid, its temperature and the consumption of electric current for heating. The results of these investigations were compared graphically with those obtained previously during forced motion of a liquid in a tube, and were found to be comparable. The experimental points approximated curves drawn on the basis of the empirical formula

$$\frac{q_{cr}}{W_\kappa P_c} = 3 \cdot 10^{-4}\left(1-\frac{P}{P_c}\right)\left(1+6.7\,\frac{\Delta i}{r}\right)\left[1+0.8\left(10^2\,\frac{W}{W_\kappa}\right)^{0.8}\right]$$

where q_{cr} is the critical heat load, P and P_c are the pressure and critical pressure, W and W_κ are the velocity of the liquid and the speed of sound in the liquid, r is the latent heat of evaporation, and Δ_i is the underheating to saturation. (ATD)

25251 (AECL–2330, pp 153–78) INVESTIGATIONS INTO THE HEAT TRANSFER FROM BUNDLES OF HEATED FINNED TUBES TO A LONGITUDINAL FLOW OF MONO-ISOPROPYLDIPHENYL. Bogdanov, F. F. Translated from pp 130–50 of Issledovaniya po Primeneniyu Organicheskikh Teplonositelei-Zamedlitelei v Energeticheskikh Reaktorakh, Atomizdat, Moscow, 1964.

The heat transfer was investigated from a bundle of heated tubes with a multifilar helical thread to a flow of monoisopropylbiphenyl heated to the boiling point. The experiments were carried out on a closed, single-tube, circulation loop with forced flow. The apparatus is described in detail. Fluid flow through the channel, the pressure of the coolant before entering the apparatus, and the consumption of electricity for heating the Al rods were investigated. These rods were in a longitudinal flow of monoisopropylbiphenyl heated to the saturation temperature and moving at Re = 500–80,000. The results are shown graphically, and empirical relations are derived for: (1) heat transfer during turbulent flow of a liquid at Re > 10,000 in the presence of displacers; (2) heat transfer at Re = 500–3,000; and (3) heat transfer from bundles with an external helical thread without displacers for Re > 10,000; and heat transfer when Re < 9,000. (ATD)

25252 HEAT-TRANSFER STUDIES UNDER THE EURATOM PROGRAMME. Grass, G. (EURATOM, Ispra, Italy). Atompraxis, 12: 215-19(Apr.-May 1966). (In German).

Research carried out under the Euratom program in the field of heat transfer in various reactor types is de-

scribed. It was found at Ispra that during heat-transfer in gas-cooled reactors extremely shallow grooves (0.1 mm) suffice to boost the heat-exchange by 60% as compared with a smooth surface, the resultant pressure-drop increasing by less than about 15%. In connection with boiling phenomena, cooling of the heating surface at the point of origin of steam bubbles was recently measured for the first time in Ispra. As regards boiling-water reactors, a program was drawn up for the investigation of heat transfer in water at pressures of 160 to 240 bar. In connection with burnout, Euratom has concluded a number of contracts with European firms, the subjects of which were coordinated with American research projects under a USA/Euratom agreement. Heat-transfer problems in organic-cooled reactors were mainly solved at Ispra, but also under the ORGEL project in cooperation with the French Research Center at Grenoble and the Dutch TNO Research Institute. The construction of several large loops at Ispra made it possible to verify results under special reactor conditions. Under Euratom's two Association Agreements on fast breeders extensive work on heat-transfer in liquid-metal-cooled fast breeders was carried out primarily by the Karlsruhe Nuclear Research Center, or assigned to Ispra. A method for observing boiling phenomena inside the channels under investigation was perfected. (auth)

25253 ANALYSIS OF LAMINAR FULLY DEVELOPED HEAT TRANSFER IN THIN RECTANGULAR CHANNELS WITH FUEL LOADING REMOVED FROM THE CORNERS. Savino, Joseph M.; Siegel, Robert; Bittner, Edward C. (Lewis Research Center, Cleveland). Chem. Eng. Progr., 61: Symp. Ser. No. 60, 84-96(1965).

An analysis is presented of convective heat transfer in thin rectangular channels such as are found commonly in nuclear reactor fuel assemblies. The velocity and temperature profiles both are assumed to be fully developed. Heating takes place in the fueled region located on the broad channel sides, but the fuel extends only part way to the corners. The short sides and portions of the broad sides that are not fueled are assumed insulated. The wall temperature distributions are shown to be strongly dependent on the spacing between the heated region and the corners. For uniform heating the maximum wall temperature shifts rapidly from the corner to the center of the broad side, as this spacing is increased from zero to only one half the distance between the broad sides. With a cosine heating distribution where the peak flux is at the fuel edges, the wall temperature gradients are more severe than for the uniform heating case. Tables of temperature distributions in the fluid are also given. (auth)

25254 MEASUREMENT OF LOCAL HEAT TRANSFER COEFFICIENTS FOR FLOW OF HYDROGEN AND HELIUM IN A SMOOTH TUBE AT HIGH SURFACE-TO-FLUID BULK TEMPERATURE RATIOS. Weiland, Walter F. Jr. (Lewis Research Center, Cleveland). Chem. Eng. Progr., 61: Symp. Ser. No. 60, 97-105(1965).

Local values of heat transfer coefficients were measured experimentally for helium and hydrogen gas flowing through an electrically heated Inconel tube. The experiment was conducted primarily to determine the effect on the heat transfer coefficient of a large density change, radially, in the heat transfer fluid. This large density change was accomplished with relatively high surface temperatures as compared to fluid bulk temperatures or more commonly referred to as high surface to fluid bulk temperature ratio. The large temperature ratio was achieved by precooling the gas with liquid nitrogen. Data were measured for local values of surface-to-fluid bulk temperature ratios up to 4.5, Reynolds numbers in the turbulent flow region, surface temperatures up to 2,300°R, heat flux up to 1,600,000 Btu/(hr)(ft^2) and length-to-diameter ratio of 250. A comparison of this data with the conventional heat transfer correlation equation (Dittus-Boelter equation) is shown on a curve of Nusselt number divided by Prandtl number vs the Reynolds number. The gas properties were evaluated at the film temperature and the Reynolds number was modified by evaluating the velocity term at the fluid bulk temperature and the density at the film temperature. (auth)

25255 IMPROVEMENT OF HEAT TRANSFER TO WATER FLOWING IN AN ANNULUS BY ROUGHENING THE HEATED WALL. Durant, William S.; Towell, Robert H.; Mirshak, Samuel (E. I. du Pont de Nemours and Co., Aiken, S. C.). Chem. Eng. Progr., 61: Symp. Ser. No. 60, 106-13(1965).

Forced convection heat transfer to water flowing in annuli was increased by roughening the heated inner walls with diamond knurls up to 0.025 in. deep. Heat transfer coefficients for the knurled surfaces, together with friction factors for the annular flow, were measured at non-boiling conditions with average fluid velocities of 10 to 30 ft/sec, film temperatures of 35° to 125°C, and equivalent diameters of $\frac{1}{4}$ to $\frac{1}{2}$ in. Burnout heat fluxes were also measured for both smooth and knurled surfaces. When compared at the same pumping power, the liquid-film heat transfer coefficients of the knurled annuli were up to 75% higher than those of smooth-walled annuli. The corresponding improvement in burnout heat flux was as much as 60%. (auth)

25256 ON THE PHENOMENON OF BOILING FLOW IN A PARALLEL ROD ARRAY. PART I. LOW PRESSURE INVESTIGATIONS. Sher, Neil C.; Kangas, Glenn J.; Neusen, Kenneth F. (Allis-Chalmers Mfg. Co., Milwaukee). Chem. Eng. Progr., 61: Symp. Ser. No. 60, 127-40(1965).

A series of low pressure experiments was undertaken with water and air-water mixtures to study the effects of tube-sheet type spacers on the axial pressure profile. The static pressures immediately behind the spacers indicate the flow re-establishes itself within two equivalent diameters of the disturbance. However, the pressure recovery which occurs at the entrance section takes approximately twelve equivalent diameters to be completed. (auth)

25257 ON THE PHENOMENON OF BOILING FLOW IN A PARALLEL ROD ARRAY. PART II. HIGH PRESSURE INVESTIGATIONS. Sher, Neil C.; Kangas, Glenn J.; Neusen, Kenneth F. (Allis-Chalmers Mfg. Co., Milwaukee). Chem. Eng. Progr., 61: Symp. Ser. No. 60, 141-56 (1965).

Experiments were performed at 600 lb/sq in. abs with mass velocities from 1.0×10^6 to 2.5×10^6 lb/(hr)(sq ft), and heat fluxes as high as 150,000 Btu/(hr)(sq ft) to measure the effect of boiling on the frictional and spacer types of pressure losses in a 6-ft-long section, as well as to measure the void fraction by a fine gamma-ray traversing technique. Results are compared with available correlations for other geometries with generally good agreement. (auth)

25258 EFFECT OF TEST SECTION PARAMETERS ON SATURATION POOL BOILING BURNOUT AT ATMOSPHERIC PRESSURE. Ivey, H. J.; Morris, D. J. (Atomic Energy Establishment, Winfrith, Eng.). Chem. Eng. Progr., 61: Symp. Ser. No. 60, 157-66(1965).

Experimental results are presented on the effect of test section parameters on saturation pool boiling burnout. The boiling condition chosen was a pool of water at atmospheric pressure and saturation temperature. The test section parameters considered were material, heater diameter, and heater wall thickness. A comparison with previously published data is made. (auth)

25259 CRITICAL HEAT FLUX OF SOME POLYPHENYL COOLANTS. Robinson, Jerry M.; Lurie, Henry (Atomics International, Canoga Park, Calif.). Contract AT(11-1)-GEN 8. Chem. Eng. Progr., 61: Symp. Ser. No. 60, 167-78(1965).

The critical heat flux (C.H.F.) of Santowax R (a polyphenyl mixture), Santowax R containing diphenyl and/or radiolytic high boilers, and coolant from the Organic Moderated Reactor Experiment (O.M.R.E.) was measured as a function of mass velocity, subcooling, and pressure under forced convection, subcooled boiling conditions. The data were correlated by equations of the form $q_c = A + B\Delta T_s G^{0.8}$. Over the range of variables covered, the critical heat flux data were correlated by: (1) Santowax R,

$q_c = 198,000 + 14.5\Delta T_s G^{0.8}$. (2) A mixture of Santowax R and 27 wt % radiolytic high boilers, $q_c = 353,000 + 16.9\Delta T_s G^{0.8}$. (3) Mixture 2 with diphenyl added to give 2.9 to 7.4 total wt % diphenyl, $q_c = 282,000 + 23.0\Delta T_s G^{0.8}$. (4) O.M.R.E., Core II coolant, $q_c = 219,000 + 29.2\Delta T_s G^{0.8}$. At the same subcooling and mass velocity, the critical heat flux increases as a result of adding radiolytic high boilers to Santowax R. For $\Delta T_s G^{0.8} \geq 11,000$, the C.H.F. of Santowax R + H.B. + diphenyl is greater than the C.H.F. of Santowax R + H.B., and that of O.M.R.E. coolant is higher than either. (auth)

25260 UNIFICATION OF ANNULAR AND FLAT INDUCTION PUMP CALCULATION METHODS. Voldek, A. I. Magnit. Gidrodin., No. 1, 116-20(1966). (In Russian).

Formulas characterizing the electromagnetic processes in the channels of annular and flat induction pumps are compared. Curves for coefficients which enable the same formulas to be applied to annular and flat induction pump calculations are calculated and presented. The magnetic Reynolds number of annular pumps, appearing in the formula for the attenuation coefficient of the pressure, is expressed in terms of the magnetic Reynolds number of flat pumps and a corresponding correction coefficient. (tr-auth)

25261 CHARACTERISTICS OF AN ELECTROMAGNETIC CONDUCTION PUMP FOR LIQUID SODIUM AT TEMPERATURES UP TO 500 DEG C. Grishin, V. K.; Kuznetsov, A. G. Magnit. Gidrodin., No. 1, 127-31(1966). (In Russian).

The method and design of apparatus for the experimental determination of the characteristics of a transformer-type d-c pump for liquid Na in the temperature range from 300 to 500°C are described. Curves of the external characteristics of the pump are presented. (auth)

25262 ELECTROMAGNETIC PUMP BASED ON PINCH-EFFECT. Mironov, O. M. Magnit. Gidrodin., No. 1, 132-6(1966). (In Russian).

An electromagnetic pump without ferromagnetic core based on the pinch effect is studied. Relations for the electromagnetic pressure rise, current, and efficiency of the pump as a function of magnetic Reynolds number and outer-to-inner radius ratio of the pipe are derived. By means of the proposed formulas pump parameters are determined, and some recommendations for design are presented. (auth)

25263 A NEW AND SIMPLE METHOD OF ESTIMATING THE LIQUID SUPERHEAT DUE TO SURFACE CONDITIONS IN NUCLEATE BOILING AND ITS APPLICATION TO SODIUM. Donne, Mario Dalle (EURATOM, Brussels). Nukleonika, 8: 133-7(Mar. 1966).

The phenomenon of bubble growth at the surface of a heating wall due to boiling of the cooling liquid is studied. A method of calculating the superheat temperature of the liquid necessary to initiate boiling as a function of the surface finish is suggested. A numerical application for sodium is presented. (auth)

25264 TEPLO- I MASSOPERENOS. TOM III. TEPLO- I MASSOPERENOS PRI FAZOVYKH PREVRASHCHENIYAKH. (Heat and Mass Transfer. Vol. III. Heat and Mass Transfer in Phase Transformation). Lykov, A. V.; Smol'skii, B. M. Minsk, Nayka i Tekhnika, 1965. 431p.

Forty-three articles are included. Separate abstracts were prepared for three. Articles not abstracted include studies of heat and mass exchange during boiling, condensation, drying, evaporation, sublimation, and other processes accompanying phase transformations; diffusion at the critical point; thermal problems with moving phase-separation boundary; and the stability of regimes of boiling and evaporation of solids in vacuum. (M.J.T.)

For abstracts of individual papers see: 25265–25267.

25265 HEAT EXCHANGE AND MIXING IN BOILING FLUIDS. Byakov, V. M.; Stepanova, O. P.; Ershler, B. V. (Inst. of Theoretical and Experimental Physics, Moscow). pp 84-99 of Teplo- i Massoperenos. Tom III. Minsk, Nayka i Tekhnika, 1965. (In Russian).

The study of the motion of gas-liquid mixtures and heat transfer in a boiling liquid is a prerequisite for solving thermophysical problems associated with boiling reactors. The growth of individual bubbles of vapor in a superheated liquid is examined, considering the cases of a stationary spherical bubble, a spherical bubble moving with respect to the liquid, and a moving nonspherical bubble. The behavior of vapor bubbles in a boiling liquid, turbulent diffusion in a boiling liquid, and regularities in the bubbling process are investigated. Results of calculations of the distribution of vapor content as a function of the level of bubbling, the dependence of the vapor flux on the vapor content, and the effect of the diameter of the bubbling column are shown and compared with experiment. (M.J.T.)

25266 HEAT EXCHANGE IN BOILING FLUIDS. Zavoiskii, V. K. (All-Union Polytechnic Inst., Moscow). pp 100-8 of Teplo- i Massoperenos. Tom III. Minsk, Nayka i Tekhnika, 1965. (In Russian).

The process of growth of a single bubble of vapor in a superheated liquid is considered, comparing calculated and measured results on the variation of the volumes of the bubbles with the distances traveled by the bubbles in the liquid and on the variation of the volumetric vapor content with reduced velocity of the vapor. The growth of an assembly of bubbles is discussed. Expressions for the coefficient of heat transfer from the boiling liquid to the vapor are found, and the moderator density and power in a reactor, the change of density during a pulse of power, and the time of compensation of the inserted reactivity are considered. (M.J.T.)

25267 CRITICAL THERMAL FLUX IN BOILING ORGANIC COOLANTS IN TUBES AND LARGE VOLUMES. Sterman, L. S.; Mikhailov, V. D.; Vilemas, Yu.; Abramov, A. I. (Moscow Power Engineering Inst.). pp 131-45 of Teplo- i Massoperenos. Tom III. Minsk, Nayka i Tekhnika, 1965. (In Russian).

Measurements of the critical heat flux in water and in three organic coolants—Dowtherm, monoisopropylbiphenyl, and ethyl alcohol—for conditions of surface boiling in tubes and volume boiling were carried out at various pressures and circulation velocities. Results are presented and compared with those of previous experimental works and of theoretical calculations using previously developed formulas. (M.J.T.)

Materials Testing

Refer also to abstracts 25590, 25591, and 26455.

25268 (ORNL-P-2107) CODES AND THE NONDESTRUCTIVE TESTING OF WELDS. Miller, Edward C. (Oak Ridge National Lab., Tenn.). 1966. Contract W-7405-eng-26. 16p. (CONF-660211-2). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From 1st Midwest Symposium on Nondestructive Testing of Welds, Chicago.

The history of the development of pressure vessel and piping codes is summarized and the problems involved in introducing new techniques, including nondestructive testing requirements, into these codes are described. These problems include the necessity for establishing procedures whose results are readily interpretable with a minimum of dispute, and capable of giving consistently reproducible results when employed by a variety of operators and shops with a variety of equipment and varying levels of ability. The generally good record of service performance of code-constructed equipment requires that the introduction of new techniques be justified on the basis of improved quality of construction consistent with the cost involved. The actual methods of nondestructive testing presently incorporated in Codes and their acceptance standards are reported in some detail. (auth)

25269 THERMAL NEUTRON IMAGE INTENSIFICATION SYSTEM. Berger, Harold (Argonne National Lab., Ill.); Kraska, I. R.; Niklas, Wilfrid F.; Schmidt, Adolph.

IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci., NS-13: 79-83(Apr. 1966).

An image intensifier tube of the vacuum tube type, sensitive to thermal neutrons has been developed and tested. The tube provides a bright visible output signal for an incoming thermal neutron image. Sensitivity, resolution, speed, contrast and relative response to radiation other than thermal neutrons all appear to be adequate for application to neutron imaging studies employing either reactor or nonreactor thermal neutron sources. The above characteristics and applications of the system are discussed. (auth)

25270 GAMMA-RAY INSPECTION OF HIGHLY RADIOACTIVE MATERIALS. Butler, J. K. (United Kingdom Atomic Energy Authority, Dounreay, Scotland). J. Brit. Nucl. Energy Soc., 5: 72-3(Jan. 1966).

A method for the measurement of gamma absorption in highly radioactive materials is described. This method permits the examination of reactor fuel elements after irradiation. It involves the use of a gamma source whose specific activity is of the same order of magnitude as that of the subject. The design of this arrangement is shown and described. (J.F.P.)

25271 NONDESTRUCTIVE DETECTION AND THICKNESS MEASUREMENT OF NICKEL PLATING ON URANIUM FUEL CORES. Mix, Paul E. (E. I. du Pont de Nemours and Co., Aiken, S. C.). Mater. Eval., 24: 253-6(May 1966). (DPSPU-64-30-13).

At the Savannah River Plant, the thickness of nickel plating on uranium fuel cores and the detection of residual nickel in aluminum-clad, nickel-plated fuel elements are being determined nondestructively by two newly developed instruments. These instruments use small permanent magnets to provide magnetic flux and "Hall-effect" devices that respond to changes in magnetic flux density. Because the magnetic permeability of nickel is about 200 times greater than that of the uranium, aluminum, or intermetallic compounds in clad uranium fuels, the presence of nickel, or variation in its thickness, causes measurable changes in flux density. The application of these instruments for routine production use in preparing fuels for nuclear reactors shows that the thickness of nickel plating can be determined to within $\pm 25 \times 10^{-6}$ in. of that measured by destructive tests, and nickel layers as thin as 50×10^{-6} in. under 0.04-in.-thick aluminum cladding can be detected. (auth)

25272 METHOD AND DEVICE FOR RADIOGRAPHY WITH NEUTRONS OF THERMAL ENERGIES. Warman, Edward A.; Welte, William D.; Garvey, Alfred T. (to General Dynamics Corp.). U. S. Patent 3,237,009. Feb. 22, 1966. Filed Mar. 29, 1963.

A device for obtaining a neutron inspection radiograph includes as a convenient and portable source of neutrons a substance that emits neutrons when gamma rays impinge upon it and a radioactive isotope that emits gamma rays of sufficient energy to cause the substance to emit neutrons. A moderating substance is interposed between the specimen and the substance emitting neutrons to moderate the neutrons impinging upon the specimen to thermal energy neutrons only. Collimating means are interposed between the moderating substance and the specimen. Some means, such as radiographic film, are provided for depicting the effect of the specimen upon the neutrons emitted by the substance. This apparatus is capable of efficient use despite the presence of extraneous gamma or x radiation. (B.L.M.)

Space Propulsion

See also ISOTOPE TECHNOLOGY — Power Application
REACTOR TECHNOLOGY — Propulsion and Space

25273 (N-65-15226) ANALYSIS OF AN ARC-JET EXHAUST. Van Camp, W. M.; McVey, F. D.; Esker, D. W.; Checkley, R. J.; Merrifield, S. E. (McDonnell Aircraft Corp., St. Louis, Mo. Research Div.). Dec. 1964. Contract NAS3-3562. 62p. (NASA-CR-54102; A-984). CFSTI $3.00 cy, $0.75 mn.

Techniques are reported for measuring the performance characteristics and nozzle exit-plane plasma parameters of hydrogen arc-jet thrustors operating in the power range of 17 to 33 kw and vacuum exhaust conditions of 0.40 to 1.40 torr. Water-cooled and radiation-cooled hydrogen arc-jet thrustors are described in terms of physical dimensions and performance parameters. Measurements are reported of thrust; specific impulse; stagnation enthalpies at the exit plane; mass flux nozzle exit-plane velocities; electron-beam attenuation in varying density environments of hydrogen, helium and argon; and electron densities. (STAR)

25274 (N-65-32573) FOLLOW-ION INVESTIGATION OF A STEADY-STATE HALL CURRENT ACCELERATOR. Final Report. Cann, G. L.; Harder, R. L. (Electro-Optical Systems, Inc., Pasadena, Calif.). Oct. 30, 1964. Contract NAS3-3568. 106p. (NASA-CR-54062; EOS-4010-Final). CFSTI $4.00 cy, $0.75 mn.

A model of the electromagnetic interaction with the plasma was postulated. Plasma is generated near the surface of the electrodes. This plasma flows downstream in an inner core and an outer cylinder, separated by a nonconducting layer. Far downstream, the two layers join together. The electric current path from anode to cathode is via this long loop. An external solenoidal magnet produces a diverging magnetic field in the region. The axial current in the outer cylinder and the applied radial magnetic field cause tangential Hall currents. These Hall currents in the jet interact with the radial magnetic field to produce the thrust. The reaction of this thrust is in the magnet. The Hall currents induce a magnetic field which tends to let the accelerated plasma flow unimpeded out of the applied magnetic field. Several models of the accelerator were tested. (STAR)

25275 (N-65-33367) DEVELOPMENT OF A COAXIAL PLASMA GUN FOR SPACE PROPULSION. Final Report. Gooding, Terence J.; Larson, Alan V.; Hayworth, Bruce R.; Ashby, David E. T. (General Dynamics/Convair, San Diego, Calif.). Apr. 1965. Contract NAS3-5759. 77p. (NASA-CR-54245; GDA-DBE-64-052-4). CFSTI $3.00 cy, $0.75 mn.

To understand the physical phenomena occurring in pulsed plasma thrustors, diagnostic techniques were selected to give convenient, rapid estimates of thrustor performance. Calorimetric efficiency was the upper limit for thrust efficiency, and ion velocity was measured by I_{sp}. Moving sheet accelerators for any I_{sp} between 2,000 and 20,000 sec and thermal efficiencies of the order of 40% were designed and constructed. Two ways of improving efficiency are being investigated: nonuniform mass loading to make the current sheet accelerate continuously and maintenance of stationary or quasi-stationary current distribution. The stationary current sheet accelerator or pulsed-arc gun has two distinct advantages over steady-state thrustors, namely: pulsed-arc guns can be operated at very low average power while at very high peak powers; and, because the propellant is also pulsed, very low ambient vacuum tank pressures can be maintained without large-scale pumping systems. Energy storage capacitors were also developed. (STAR)

25276 (N-65-35350) MISSION ORIENTED ADVANCED/NUCLEAR SYSTEM PARAMETERS STUDY. VOLUME I. SUMMARY TECHNICAL REPORT. Final Report, April 1963-March 1965. Chovit, A. R.; Plebuch, R. K.; Kylstra, C. D. (Space Technology Labs., Inc., Redondo Beach, Calif.). Contract NAS8-5371. 75p. (NASA-CR-67316; STL-8423-6005-RU-000(Vol.1)). CFSTI $3.00 cy, $0.75 mn.

A summary of the study approach, basic guidelines, and assumptions that were used in a comprehensive, parametric lunar and interplanetary mission and solid-core, nuclear engine analysis are given. The analyses performed and the

analytic techniques generated in developing three computer programs for the IBM 7094 are summarized. These three programs, the SWingby Optimization Program (SWOP), the FLyby Optimization Program (FLOP), and the Nuclear Rocket Engine Optimization Program (NOP) were employed to generate over 20,000 mission simulations, and to investigate the effect on engine and vehicle performance of variations in nuclear engine design parameters and constraints. A summary of the results is presented which establishes an optimum thrust range for the advanced nuclear engine, determines the design characteristics of a compromise advanced nuclear engine, and establishes the sensitivity of the vehicle to variations in mission, engine, and vehicle parameters and modes. (STAR)

25277 (N-65-35410) MISSION ORIENTED ADVANCED NUCLEAR SYSTEM PARAMETERS STUDY. VOLUME VI. Final Report, April 1963-March 1965. Chovit, A. R.; Plebuch, R. K. (Space Technology Labs., Inc., Redondo Beach, Calif.). Contract NAS8-5371. 17p. (NASA-CR-67317; STL-8423-6010-RU-000(Vol.6)). CFSTI $1.00 cy, $0.50 mn.

The development of future space technology, supplementary research on alternative operational and system techniques, and specification of vehicle weight requirements and subsystem performance characteristics are considered in relation to parameters for lunar and interplanetary missions. Selection of the nuclear engine design for such missions is discussed in terms of design constraints, achievable engine performance, and engine firing times. Launch weight, aerodynamic braking, and mission year are considered as the areas which exert the greatest influence on overall mission performance characteristics; and a table gives the variation of vehicle weight with mission year, with earth aerodynamic braking capability, and as a function of mass fraction and mission year. Vehicle weight is graphed against nozzle chamber temperature and expansion ratio and specific impulse and nozzle chamber pressure. Also considered are Mars aerodynamic braking. Venus swingby missions, clustered engines, modular stage designs, and launch windows and holds. Mission subsystem requirements are listed. (STAR)

25278 (N-66-15788) DEVELOPMENT OF ELECTRICAL SWITCHGEAR FOR SPACE NUCLEAR ELECTRICAL SYSTEMS. Quarterly Progress Report No. 4, September 4-December 4, 1965. Powell, A. H. (ed.) (General Electric Co., Cincinnati, Ohio. Space Power and Propulsion Section). [1966]. Contract NAS3-6467. 65p. (NASA-CR-54861). CFSTI $3.00 cy, $0.75 mn.

Progress in the development of electrical switchgear for nuclear-electric systems is reported. (D.C.W.)

GEOLOGY, METEOROLOGY, AND MINERALOGY

General

Refer also to abstract 25319.

25279 RECENT RESEARCHES IN THE FIELDS OF HYDROSPHERE, ATMOSPHERE AND NUCLEAR GEOCHEMISTRY. Miyake, Yasuo; Koyama, Tadashiro (eds.). Nagoya, Japan, Sugawara Volume, Nagoya University, 1964. 412p. Maruzen Co., Ltd., Tokyo.

Twenty-five papers on atmospheric, hydrospheric, and nuclear geochemical research are presented. Separate abstracts were prepared for 8 papers. One paper was previously abstracted for NSA and appeared as abstract 19: 30417. (M.C.G.)

For abstracts of individual papers see: 24835, 24851, 25297–25300, 25313, and 25715.

Meteorology

See also Site Survey and Selection

25280 NEW TECHNIQUE FOR MEASURING WIND VELOCITY PROFILES IN THE ATMOSPHERE. Halverson, S. L. (Argonne National Lab., Ill.); Moses, H.; Kastner, J.; Banfield, T. V.; Mueller, E. A.; Stout, G. E. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci., NS-13: 54-63(Apr. 1966).

A new technique for measuring wind velocity profiles in the atmosphere with the use of an ionized column of air is reported. An experiment is described in which a conical column of air was ionized by a vertically pointed CP-5 fuel element and detected by a AN/MPQ-33 and a modified AN/APS-4 radar. The application of the observed experimental results to the measurement of wind velocity profiles is discussed. (B.G.D.)

Natural Radioactivity and Fallout

See also HEALTH AND SAFETY

25281 (CEA-R-2930) ESSAI D'EVALUATION DU DEPOT CUMULATIF DE ^{90}Sr DANS PLUSIEURS STATIONS FRANCAISES. (Attempt to Evaluate the Cumulative Deposit of ^{90}Sr in Several French Centers). Garnier, Arlette (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Mar. 1966. 14p. (EUR-2644.f). Dep. mn.

A method for measuring fallout in years before establishment of systematic controls is presented. Measurements are based on the assumptions that: rainfall varies little in locations geographically proximate; and ^{90}Sr deposits can be determined for several locations by correcting values measured at a single station. The method was applied to ^{90}Sr calculations at Ispra, Mol, and several French centers. Results showed that the method was valid for calculating fallout prior to 1960. (H.G.D.)

25282 (RLO-1750-4) SOME NON-BIOLOGICAL ASPECTS OF COLUMBIA RIVER RADIOACTIVITY. Osterberg, Charles; Cutshall, Norman; Johnson, Vernon; Cronin, John; Jennings, David; Frederick, Lawrence (Oregon State Univ., Corvallis. Dept. of Oceanography). Mar. 4, 1966. Contract AT(45-1)-1750. 17p. (CONF-660507-3). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

For Presentation at Symposium for the Disposal of Radioactive Wastes into Sea, Oceans, and Surface Waters, Vienna.

The importance of the Columbia River, its estuary, and the adjacent ocean as a radioecology laboratory is emphasized. Radioactivity measurements have been made in sediments, water, and biota of the Columbia River and Pacific Ocean. Studies of sediment and water radioactivity are reviewed. Methods for measuring ^{65}Zn and ^{51}Cr in sediments and the nature of the binding mechanisms in sediments are described. Studies of ion exchange on sediments showed that less than 5% of the ^{65}Zn on Columbia River sediments was exchangeable. Of the three parameters measured, radioactivity in water was the most difficult due to the dilution factor. Methods for removing trace metals from water are compared. Chromium-51 is regarded as a positive and sensitive tracer of Columbia River water at sea because no other source of ^{51}Cr exists in the Northeastern Pacific Ocean. Development of techniques for measuring ^{65}Zn, ^{124}Sb, ^{54}Mn, and ^{51}Cr in the Columbia River plume at sea are discussed. (H.G.D.)

25283 INVESTIGATION OF THE GAMMA ACTIVITIES AND GAMMA SPECTRA OF SNOW SAMPLES. Toth, A.; Zsoldos, T.; Urban, A. Acta Phys. Acad. Sci. Hung., 20: 305-22(1966).

An analysis of the total gamma activities and the gamma spectra of 25 samples of snow and one of rainwater-snow collected in Hungary (between 16°–22° longitude and 46°–48° latitude) between 29th January and 22nd February 1963 revealed that (a) the ^{137}Cs-equivalent total gamma activity is on the average $5.1 \cdot 10^{-7}$ μc/ml; (b) the total beta concentration calculated from this is $\approx 1.2 \cdot 10^{-6}$ μc/ml; elements detected with great probability: ^{141}Ce, ^{144}Ce, ^{103}Ru, ^{7}Be, ^{137}Cs, ^{95}Zr and ^{95}Nb. Age of fission products: ranging from 50 to 80 days. ^{137}Cs and (^{95}Zr + ^{95}Nb)-concentrations were estimated. Our total activity data agree well with those of other authors; the results of our selective determinations are of the order of the values obtained by other authors, differences being due to losses in collection and sample treatment. Our Szeged sample distinguished itself from the others by its anomalously high (approximately three times higher) radioactivity. (auth)

25284 RADIOACTIVITY MEASUREMENT OF THE HANAOKA AND KOSAKA MINES, AKITA PREFECTURE. Sano, Shun-ichi; Murozumi, Masayoshi. Chishitsu Chosasho Geppo, 16: 163-73(Mar. 1965). (In Japanese).

Natural gamma radioactivity was measured through the drill holes and in the galleries of the Hanaoka and Kosaka mines. These ore deposits are representative among Kuroko (black ore) type deposits, occurring in tuffaceous sediments of Miocene age. Radioactivity anomalies were detected at the marginal parts of ore bodies and the altered zone of surrounding rocks. These anomalies are mostly due to concentration of uranium, as much as 0.05 percent U_3O_8, at alteration clays, as pointed out by Shoichiro Hayashi summarizing the studies at several Kuroko deposits. The relative increase of radioactivity was observed at the ferrous manganese zone or the siliceous nodule which is characteristic of the upper part of mineralized zone. It is also noticed that the lower part of ore body and the underlying rhyolite is highly radioactive. Natural radioactivity logging through the exploratory drill hole would be, therefore, useful for the prospecting of Kuroko type deposit. (auth)

25285 ARTIFICIAL RADIOACTIVITY REFERENCE HORIZONS IN GREENLAND FIRN. Crozaz, G. (Free University of Brussels); Langway, C. C. Jr.; Picciotto, E. Earth Planet. Sci. Lett., 1: 42-8(Jan. 1966).

Total beta measurements were made on melt water samples from a stratigraphically dated firn core profile from the inland Greenland ice sheet (77°10′N, 61°08′W). A marked increase in radioactivity is found in the 1953 firn layer which corresponds to the first important fallout from nuclear test bombs. The pre-1953 natural beta activity is 5 dpm/kg. The influx of artificial debris from the Ivy tests in 1953 is noted by a sharp rise in beta activity to 10 dpm/kg. Total ^{90}Sr deposit to June 1964 is 9.3 ± 1.5 millicuries/km^2 (24 ± 4 mC/mi^2). Average ^{210}Pb activity at time of deposit is 3.9 ± 0.4 dpm/kg. (auth)

25286 SOLUBILITY AND PLANT AVAILABILITY OF RADIONUCLIDES IN REACTOR-ACTIVATED SOILS. Nishita, H.; Haug, R. M.; Steen, A. J. (Univ. of California, Los Angeles). Contract AT(04-1)-GEN-12. Health Phys., 12: 615-20(May 1966).

The solubility radionuclides formed in reactor activated soils were determined by equilibrium batch and leaching methods and the plant availability of these radionuclides was determined by a modified Neubauer technique. The gamma activity of the equilibrium extracts of activated soils varied from 0.17 to 20.22, 0.36 to 25.09 and 0.20 to 28.76 per cent of total activity in deionized H_2O, 0.1 N HCl and 1 N NH_4Ac, respectively, about 22 hr after irradiation. The activity leachable by the above extractants about 2.5 hr after activation varied among the soils, respectively, as follows: gamma, 0.35 to 16.16, 4.95 to 38.74 and 3.60 to 22.61 per cent; and beta, 0.55 to 17.09, 8.01 to 58.75 and 2.42 to 33.94 per cent. In every instance, the percentage of leachable beta activity was greater than the leachable gamma activity of the corresponding soil. Thus, the relative extraction of beta activity was greater than that of the gamma activity. This effect was reflected in the 18-day-old barley seedlings, which showed much greater beta activity than gamma activity. The dominant gamma-emitting radionuclide in the plants was ^{86}Rb, although ^{46}Sc was the dominant radionuclide in the soil at the time of harvest. (auth)

25287 TRANSFER OF ^{89}Sr FROM PLANTS TO RABBITS IN A FALLOUT FIELD. Martin, W. E.; Turner, F. B. (Univ. of California, Los Angeles). Health Phys., 12: 621-31(May 1966).

A study was conducted in the fallout field produced on July 6, 1962 by Project Sedan to formulate a mathematical model to represent the relationship between gamma dose rates and initial ^{89}Sr concentrations on fallout-contaminated plants and the time-specific relationship between ^{89}Sr concentrations on plants and in the bone ash of rabbits collected at the same times and locations in the fallout field. Estimates of gamma dose rates 24 hr after the detonation were based on the results of aerial radiometric surveys. Estimates of the time-specific concentrations of ^{89}Sr on plants and in rabbit bone ash were based on analyses of samples collected before and 5, 15, 30, and 60 days after the detonation at twenty representative locations in the SEDAN fallout field. Correlation and regression coefficients based on estimated gamma dose rates and observed ^{89}Sr concentrations in plant and bone ash samples were highly significant, and analyses of variance indicated no significant deviations from linear regression. The average initial concentrations of ^{89}Sr on desert shrubs in the SEDAN fallout field were approximately 103 pc/g per mR/hr. The average concentrations of ^{89}Sr in plant samples collected 5, 15, 30, and 60 days after the detonation were 1436, 909, 544, and 313 pc/g respectively. The average concentrations of ^{89}Sr in rabbit bone ash samples collected 5, 15, 30, and 60 days after the detonation were 863, 1680, 2097, and 1389 pc/g respectively. Estimates based on the 18-day effective half-life of ^{89}Sr on plants indicated an effective half-life of about 20 days for ^{89}Sr in rabbit skeletons. Estimates suggested that only 5.75 per cent of the ^{89}Sr ingested was assimilated and deposited in rabbit bone. An exponential model based on the parameters described above was tested and found to provide a reasonable representation of the time-specific relationship between ^{89}Sr concentrations on fallout-contaminated plants and in rabbit bone ash. Using the same model to estimate the infinity doses delivered by ^{89}Sr to rabbit bone, indicated a range from about 0.1 to 9.5 rad and an average of 1.12 ± 0.36 rad in areas 12 to 110 miles from ground zero. Estimates of integrated doses indicated that 93 per cent of the infinity dose was delivered during the first 120 days after the detonation. (auth)

25288 DETERMINATION OF PARTICLE SIZE CHARACTERISTICS OF OLD AND FRESH AIRBORNE FALLOUT BY GRADED FILTRATION. Shleien, B.; Gaeta, N. A.; Friend, A. G. (Public Health Service, Winchester, Mass.). Health Phys., 12: 633-9(May 1966).

Using a collection system consisting of three graded filters placed in series, a study was conducted on the particle size characteristics of airborne fallout. Initial collections made during March and April 1964, consisted of fission products with an effective age of 440 to 550 days. Specific nuclides measured in these samples included $^{144}Ce-^{144}Pr$, ^{125}Sb, ^{137}Cs, $^{95}Zr-^{95}Nb$, ^{54}Mn, $^{106}Ru-^{106}Rh$ and ^{90}Sr. Either gamma spectrometry or radiochemistry was used for quantitative estimations. During the latter part of October and throughout November 1964, a second series of collections were made which included fresh fission product material presumably resulting from the atmospheric nuclear detonation in mainland China. In addition to the above nuclides, these samples were analyzed for ^{141}Ce, $^{132}Te-^{132}I$, ^{131}I, $^{103}Ru-^{103}Rh$, $^{140}Ba-^{140}La$ and ^{89}Sr. Differences in the particle size distribution of material on each filter were determined by optical microscopy. For older debris, at least 88 per cent of the total activity was associated with particles having diameters of less than approximately 1.75 μ. In fresh fallout, certain radionuclides were initially associated with larger particles. With time, this distribution gradually decreased due to settling out of larger active particles. Data are presented on the degree of radionuclide fractionation which occurred in each size group. (auth)

25289 ANALYSIS OF HIGHLY RADIOACTIVE FALLOUT PARTICLES FROM CHINESE NUCLEAR TEST. I. Kemmochi, Mikio (Japan Defence Agency, Tokyo). J. Nucl. Sci. Technol. (Tokyo), 3: 106-13(Mar. 1966).

Highly radioactive fallout particles resulting from the first Chinese nuclear explosion of 16 Oct., 1964, were studied by x-ray microanalysis, x-ray microdiffraction and neutron activation analysis. Most of these particles are quite or nearly spherical, blackish colored, 10–15 μ in diameter and fairly hard. They appeared to bear some internal stress, and were of amorphous structure. Qualitative and quantitative analyses of one of these particles by means of an electron probe x-ray microanalyzer revealed a large portion of Al, a fair portion of Fe, Ca and Ti as well as a very small portion of K. These elements are not uniformly distributed on the particle surface. (auth)

25290 BEHAVIOR AND TRANSPORT OF RADIONUCLIDES IN THE COLUMBIA RIVER BETWEEN HANFORD AND VANCOUVER, WASHINGTON. Perkins, R. W. (Battelle-Northwest, Richland, Wash.); Nelson, J. L.; Haushild, W. L. Contract AT(45-1)-1830. Limnol. Oceanog., 11: 235-48(Apr. 1966).

A study of the behavior and transport by the Columbia River of the eleven radionuclides ^{46}Sc, ^{51}Cr, ^{54}Mn, ^{58}Co, ^{59}Fe, ^{60}Co, ^{65}Zn, $^{95}Zr-^{95}Nb$, ^{106}Ru, ^{124}Sb, and ^{140}Ba was carried out in the river reach between Pasco and Vancouver, Washington, during the period January 1964 through January 1965. This study was accomplished by direct counting of water salts and filter samples on a multidimensional gamma spectrometer and represents the first measurements of the interactions of most of these radionuclides in the river. Through this multiple tracer technique, the specific and relative behaviors of these radionuclides in regard to their sorption by and movement with suspended particulate matter in the Columbia River were determined. Depletion of these radionuclides from the river during transport and the radionuclide inventory in the stream bed for the river reach between Pasco and Vancouver were also estimated. (auth)

25291 DIAGENESIS OF THORIUM ISOTOPES IN DEEP-SEA SEDIMENTS. Antal, Paul S. (Univ. of Miami, Fla.). Limnol. Oceanog., 11: 278-92(Apr. 1966).

^{227}Th, ^{230}Th, and ^{232}Th were extracted from Caribbean Sea sediment samples of known age using 8N HNO_3 or concentrated HCl. The yields were compared with the radionuclide content obtained by complete dissolution of the sample and with previously reported data on red clays in Pacific Ocean cores. These comparisons indicated that the internal consistency of dates and sedimentation rates is insufficient to prove the validity of leaching procedures. The nitric acid leaching yields of authigenic ^{230}Th decreased

with depth in the core, that is, with sample age; whereas leaching of ^{232}Th was independent of depth. It is suggested that the initially soluble precipitate of ^{230}Th is transformed in the sediment to a more acid-resistant state, with the apparent half life of this transformation as 24,000 years at 3C. Therefore, in the solution obtained by partial extraction, the decrease of the ratio $^{230}Th : ^{232}Th$ with depth in the core is due not only to radioactive decay but also to the decreased solubility of authigenic ^{230}Th. Thus, sedimentation rates calculated from ($^{230}Th : ^{232}Th$) solution may be too low by a factor of three. (auth)

25292 DETERMINATION OF β-RADIOACTIVITY IN SOME MAIZE VARIETIES. Zinca, S. Lucrari Stiint. Inst. Agron., 57-60(1963).

Five samples of maize seeds (Zea mays), harvested around the town of Iasi (Jassy), were studied. The total β radioactivity (A_1) was determined, as well as the β-radioactivity of the ^{40}K (A_2) isotope. The possible contamination with other isotopes ($A = A_1 - A_2$) was estimated. The fact that all the differences $A = A_1 - A_2$ were positive indicated the existence of other radioactive isotopes. The calculated β radioactivity (A) did not exceed the maximum permissible doses. (Rum. Sci. Abstr.)

25293 RADIOACTIVITY OF THE WINES IN THE HUSI VINEYARDS. Luca, I. Lucrari Stiint. Inst. Agron., 217-21(1963).

Experiments were performed on 60 wine samples from the 1960 and 1961 vintages, taken from various points in this wine region. It was established that the radioactivity (β and γ radiations) of these wines varied from 0.38 to 1.63 mμ lu/l, differing from one part of the region to the other, even for the same variety and from one variety to another. Old wines generally possessed a smaller degree of radioactivity than new wines. (Rum. Sci. Abstr.)

25294 FRACTIONATION PHENOMENA IN DEBRIS FROM THE CHINESE NUCLEAR EXPLOSION IN MAY 1965. Persson, G. (Research Inst. of National Defence, Stockholm). Nature, 209: 1193-5(Mar. 19, 1966).

On May 14, 1965, the second Chinese nuclear device was exploded over the western part of China. Debris from this test found in high-altitude air samples collected over Sweden at the end of May and beginning of June was analyzed by autoradiography of filters and γ spectroscopy for content of ^{140}Ba, ^{141}Ce, ^{131}I, ^{103}Ru, ^{95}Zr, and ^{95}Nb. In stratospheric samples the background in the γ spectra from ^{137}Cs, ^{106}Ru, and ^{144}Ce of older origin was appreciable. As only one test was performed, the age of the debris was well defined and provided a good opportunity for the investigation of fractionation phenomena. Results indicated that fractionation phenomena occurring in small particles may be related to the rather high incorporation of inactive materials and the resulting low specific activity of small particles. (C.H.)

25295 STUDIES ON THE RADIOACTIVE DISEQUILIBRIUM IN URANIUM BEARING ORES. Parekh, P. P.; Das, M. Sankar (Atomic Energy Establishment, Trombay, India). pp 138-43 of Proceedings of the Nuclear and Radiation Chemistry Symposium, 1964. Trombay, India, Atomic Energy Establishment, 1965.

Radioactive disequilibrium in uranium-bearing ores is caused either by the preferential leaching of uranium and/or its long-lived daughter products, ^{230}Th, ^{226}Ra, and ^{210}Pb, or by loss of radon (^{222}Rn). By comparing the relative abundances of the various key isotopes in a geological specimen under investigation with the equilibrium abundances of the corresponding key-isotopes in a standard pitchblende ore, the equilibrium conditions of a few radioactive deposits from the states of Gujarat, Rajasthan, and Bihar were evaluated. The limitations of this approach are discussed. (auth)

25296 ^{90}Sr FALLOUT: COMPARISON OF RATES OVER OCEAN AND LAND. Broecker, Wallace S. (Columbia Univ., Palisades, N. Y.); Rocco, Gregory G.; Volchok, H. L. Science, 152: 639-40(Apr. 29, 1966).

Measurements of strontium-90 in waters residing on the Bahama Banks for periods between 12 and 180 days suggest that fallout rates onto these waters are substantially the same as the average rates at all fallout collection stations between 20° and 30° north latitude. If the amount of precipitation on the Bahama Banks is reasonably representative of the oceanic areas in this latitude band, our results support the conclusion that the amount of strontium-90 deposited per unit area of ocean surface is within a factor of 2 of that on land. (auth)

25297 IONIUM/THORIUM GEOCHRONOLOGY ON MIAMI CORE A 254-BR-C. Goldberg, Edward D.; Koide, Minoru; Griffin, John J. (Univ. of California, San Diego, La Jolla). pp 117-26 of Recent Researches in the Fields of Hydrosphere, Atmosphere and Nuclear Geochemistry. Miyake, Yasuo; Koyama, Tadashiro (eds.). Nagoya, Japan, Sugawara Volume, Nagoya Univ., 1964.

$^{230}Th/^{232}Th$ ratios from leached samples and from samples totally dissolved were compared for a Caribbean Sea sediment. The differences in the value of the ratio arose primarily from the introduction of ^{232}Th in the detrital minerals to the preparate for radioactive assay. Similar ages for various levels of the core were obtained by either the ^{230}Th/thorium technique using leaching or by the ^{230}Th/protactinium method. (auth)

25298 ISOTOPIC COMPOSITION OF LEAD IN THE SEDIMENTS NEAR JAPAN TRENCH. Chow, Tsaihwa J. (Univ. of California, La Jolla); Tatsumoto, M. pp 179-83 of Recent Researches in the Fields of Hydrosphere, Atmosphere and Nuclear Geochemistry. Miyake, Yasuo; Koyama, Tadashiro (eds.). Nagoya, Japan, Sugawara Volume, Nagoya Univ., 1964.

The isotopic composition of lead in sediments near the Japan Trench was determined. The values are: $^{206}Pb/^{204}Pb = 18.45$; $^{207}Pb/^{204}Pb = 15.63$; and $^{208}Pb/^{204}Pb = 38.68$. The μ and κ values of the source material were also calculated to be 8.8 and 3.9, respectively. (auth)

25299 PRELIMINARY REPORT ON THE ISOTOPIC COMPOSITION OF LEADS IN LAVAS FROM THE HAWAIIAN ISLANDS. Patterson, Clair Cameron (California Inst. of Tech., Pasadena). pp 257-61 of Recent Researches in the Fields of Hydrosphere, Atmosphere and Nuclear Geochemistry. Miyake, Yasuo; Koyama, Tadashiro (eds.). Nagoya, Japan, Sugawara Volume, Nagoya Univ., 1964.

The isotopic compositions of some leads in Hawaiian lavas are listed. These leads did not show the expected high values of ^{206}Pb, but were even less radiogenic than continental basalt leads. Furthermore, the difference between leads from widely separated magma chambers (islands of Oahu and Hawaii) was substantial. There was a suggestion, in the Hualalai lavas, that lead became more radiogenic in the acid differentiates, since the two lead samples from the 1801 flow are regarded as isotopically different. The data show that different areas of the Pacific contain leads of entirely different geneses. (M.C.G.)

25300 DISTRIBUTION OF URANIUM IN THE INDIAN AND THE SOUTHERN OCEAN WATERS. Torii, Tetsuya (Chiba Inst. of Tech., Japan); Murata, Sadao. pp 321-34 of Recent Researches in the Fields of Hydrosphere, Atmosphere and Nuclear Geochemistry. Miyake, Yasuo; Koyama, Tadashiro (eds.). Nagoya, Japan, Sugawara Volume, Nagoya Univ., 1964.

The content of uranium in sea waters collected on the route from Japan to Antarctica during the fifth and the sixth cruises of Japanese Antarctic Research Expedition (1960–61, 1961–62) on board the M. S. Soya, and at the Drake Passage during the cruise of TRIDENTE-3 (Feb.–Mar., 1963) on board the S.S. Capitan Canepa, which belongs to the Argentine Navy Hydrographic Service, was determined. Uranium was determined by the fluorometric method using a transmission type fluorometer after separation by solvent extraction and fusion with sodium fluoride. The results showed that the uranium content in surface waters ranged from 2.7 to 3.2×10^{-6} g/l in the Indian Ocean Basin in the Antarctic Ocean, 2.7 to 3.5×10^{-6} g/l in the Drake Passage, 2.5 to 3.5×10^{-6} g/l in the

Indian Ocean, and 2.5 to 3.3 × 10^{-6} g/l in the South China Sea. Judging from the mean value of 0.5 × 10^{-13} g/l for radium in the Indian Ocean the ratio of radium to uranium may be 4 to 6% of the secular equilibrium amount. (auth)

Site Survey and Selection

25301 (BNL–10137) SITE SELECTION IN RELATION TO ENGINEERED SAFEGUARDS: AN AMERICAN VIEW. Kouts, Herbert J. (Brookhaven National Lab., Upton, N. Y.). Apr. 1966. Contract AT(30-2)-Gen-16. 15p. (CONF-660312–3). Dep. mn. CFSTI $1.00 cy, $0.50 mn.
From Nederlands Atoomforum, Utrecht.

The early nuclear reactors in the United States were with one exception placed in locations relatively distant from cities. In part, the decision to operate reactors at such locations recognized the potential hazards of such installations. Economic considerations lead to desires to place electricity-generating reactors near cities. For this reason, the USAEC has issued regulations to indicate how sites proposed for power reactors should be evaluated. The assessment can recognize the provision of "engineered safeguards" in the reactor plant, but no clear indication is given as to how the existence of such safeguards would modify the conclusions. The application has proceeded on a case-by-case basis. The evolution of the evaluation of reactor sites in the United States is described, and a personal view of some of the trends is given. (auth)

25302 (UCRL-Trans–1320) GEOLOGIC AND GEOTECHNICAL STUDIES ON PROPOSED SITES FOR A 300 Gev ACCELERATOR. Gervaise, J.; Mallet, Ch. Translated for Lawrence Radiation Lab., Univ. of California, Berkeley, from report AR-Int-SG–65-28. Nov. 1965. 48p. Dep. mn. JCL $4.60 fs, $1.64 mf.

A questionnaire for aiding in selecting a site for a 300-Bev synchrotron is included. All necessary geological terms necessary for the engineer's understanding are defined and discussed in detail. Rock mechanics and mechanical borings of the selected site are discussed. (M.O.W.)

Techniques and Equipment

Refer also to abstract 25404.

25303 (AD–626946) UTILIZATION OF RIOMETERS FOR THE DETECTION OF NUCLEAR EXPLOSIONS IN SPACE. Potts, B. C. (RAND Corp., Santa Monica, Calif.). Jan. 1966. Contract SD-79. 31p. (RM–4760-ARPA). CFSTI $2.00 cy, $0.50 mn.

An investigation is presented on the detection of overhead nuclear explosions in space by riometer measurement of the effects of explosion-induced ionization on the absorption of high-frequency cosmic noise. The induced ionization is calculated as a function of height and time for a 1-kT x-ray impulse having temperatures of 0.5, 1.0, and 2.0 kev and having burst heights from 1,000 to 100,000 km. The absorption at each height due to the induced ionization is then calculated at a radio frequency of 30 Mc. In order to determine the change in the effective antenna temperature as a function of time at the riometer, the total absorption through the ionosphere is then determined. The response of a riometer with several time constants is found for this sharp change in received cosmic noise power. Detection ranges are calculated for each x-ray temperature and several possible riometer time constants based on the criterion that the nuclear burst must produce a 1-db peak response in the diode current of the riometer. These detection ranges are tabulated and compared with those that were found neglecting riometer response time. (auth)

25304 (BNWL–241) LASER INTERFEROMETER STRAIN SEISMOGRAPH: DESCRIPTION AND DISCUSSION OF THE FEASIBILITY DEMONSTRATION EXPERIMENT. Brenden, B. B.; Jacob, R. B. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). May 1966. Contract AT(45-1)-1830. 14p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

A feasibility demonstration of a laser strain seismograph, its unique characteristics, and its potential uses are described. (M.O.W.)

25305 (PNE–801F) SHOCK FRONT STUDIES OF THE HANDCAR EVENT. Project HANDCAR. Marks, R. E.; Rogers, L. A. (Lawrence Radiation Lab., Univ. of California, Livermore). Aug. 1965. Contract W-7405-eng-48. 64p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

Close-in shock wave and seismic effects were measured subsequent to a 12 kt detonation in a Nevada Test Site dolomite media and compared with predetonation code predicted results. Comparative agreement of experimental stresses with calculated stresses in the hydrodynamic pressure region was within 13%, whereas similar comparisons in the low pressure area indicated a maximum disagreement of 390%. Brief descriptions of the code, code input data, and code predicted results are also presented along with more detailed descriptions of the shock wave instrumentation, its installation and checkout, and the measured results. (auth)

25306 (PNE–913F) ANALYSIS OF SURFACE SEISMIC DATA. Project PALANQUIN. Davis, Lawrence L. (Beers (Roland F.), Inc., Alexandria, Va.). Dec. 7, 1965. Contract AT(29-2)-1163. 60p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

Palanquin was the first nuclear event at Pahute Mesa and also the first nuclear cratering test in rhyolite. A program of instrumentation was designed for recording the ground motions from this unique event. Peak ground motions were predicted for each station so that the instruments could be set at the proper recording levels. The distances at which the peak acceleration would be 0.1 g and 0.001 g were predicted. The recorded peak values of ground motion are presented in tabular and graphical form. Where appropriate, least-squares regression equations were fitted to the data. Comparisons of the observed data with the appropriate prediction equation show that the predictions were higher than the observed acceleration and velocity and lower than the observed displacement. However, the differences are small and the prediction equations are considered adequate for the present time. Data obtained will be useful in the future for scaling determinations and also for comparison of ground motions from cratering and contained events. (auth)

25307 (UCRL–13204) DETECTION OF CEMENT DUST CLOUDS WITH A PULSED RUBY LIDAR. Phase 1 Report. Ligda, Myron G. H. (Stanford Research Inst., Menlo Park, Calif.). Mar. 4, 1966. Contract AT(04-3)-115. 21p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.
For Univ. of California Lawrence Radiation, Livermore.

An experiment conducted at Test Site 300 on 5 February 1966 in which the SRI lidar was used to detect clouds of cement dust dispensed by helicopter was entirely successful. The lidar operated satisfactorily under somewhat adverse weather conditions, the cement clouds were detected well after they had dispersed below visibility (even as viewed against a white cloud background), and the experimental conditions approximated to some degree those that might be encountered at the Nevada Field Site. Based on the signal-to-noise ratios observed at close ranges, if the reflectivity of the cement dust clouds approximates that of the dust cloud produced by a nuclear explosion, it should be possible to detect the latter at ranges well over 10 miles with this same equipment. Larger ranges could be expected if the dust cloud contains a higher concentration of particles, larger size particles, and/or some particles of crystalline form such as quartz, mica, or ice, which will produce strong specular reflections. The primary limitation of the lidar is its low firing rate (about 2 per minute, maximum). (P.C.H.)

25308 GEOLOGIC AGE DETERMINATION WITH ^{36}Cl. Bagge, E.; Wilkomm, H. Atomkernenergie, 11: 176-84 (May-June 1966). (In German).

In salt sediments or lakes containing chlorine salts, the main part of cosmic neutrons is absorbed by chlorine, producing ^{36}Cl. ^{36}Cl has a half life of 3 × 10^5 years, and

therefore, in the range from 10^5 to 10^6 years, its activity is a measure for the age of the salt sediments on the surface of the earth. In this way the age of a Turkish salt lake was found to be 0.9 to 1.4×10^6 years. With the scintillation method used, it is possible to measure specific activities down to 1.5×10^{-15} C/g = 4×10^{-3} dpm/g. Cleaning of salts by fractionated crystallization and scintillation properties of organic chlorinated liquids are described. (auth)

25309 STUDY ON NATURAL GAMMA-RAY LOG. Sano, Shunichi (Geological Survey Inst., Japan). Butsuri Tanko, 18: 110-19(Sept. 1965). (In Japanese).

This report represents an overall review of the author's works on natural gamma ray logging. The errors based on some simplified assumptions in relation to effective length of detector of the estimated thickness of stratum or the estimated boundary of strata are theoretically discussed. Some characteristics of actual detectors, as well as some electronic circuits, are described. Applications to uraniferous ore deposit, "Kuroko" type metallic ore deposit, and coal field are briefly summarized. (auth)

25310 ASTROPHYSICAL PHENOMENA AND RADIOCARBON. Konstantinov, B. P.; Kocharov, G. E. (Ioffe Inst. of Physics and Tech., Leningrad). Dokl. Akad. Nauk SSSR, 165: 63-4(Nov. 1, 1965). (In Russian).

Although the determination of the causes of variation in the ^{14}C content of annual rings of trees constitutes a complex problem, a comparison of the radiocarbon activity of such rings with known astronomical phenomena is investigated. An example, the increase in ^{14}C content in the year 1700 and around 1050 is presented. It is known that the supernova Cassiopeia A exploded in 1700, and that the supernova in the Crab nebula exploded in 1054. If the composition of the electromagnetic radiation emitted by the explosion of a supernova contains gamma quanta with energies of tens of Mev, then it can generate ^{14}C atoms in the earth's atmosphere by the reactions $^{16}O(\gamma,n)^{15}O$, $^{14}N(n,p)^{14}C$; $^{14}N(\gamma,n)^{13}N$, $^{14}N(n,p)^{14}C$; $^{16}O(\gamma,2p)^{14}C$. An estimate shows that the probability of such formation of a ^{14}C isotope by a gamma quantum of several tens of Mev is 1%. An estimate of the amount of energy emitted by the explosion of a supernova in the form of hard gamma radiation was made assuming that a 1% change in the activity of ^{14}C could be measured. For Cassiopeia A (about 1700), the value obtained is 10^{51} ergs; for the Crab nebula and Kepler supernova (1604), 10^{50} ergs, and for the supernova of 1572, 10^{49} ergs. These values do not contradict the existing estimates of the energetics of supernovae. (ATD)

25311 THE ISOTOPIC COMPOSITION OF LEAD IN IGNEOUS ROCKS. I. THE ORIGIN OF SOME TERTIARY GRANITES. Hamilton, E. I. (Radiological Protection Service, Sutton, Eng.). Earth Planet. Sci. Lett., 1: 30-7 (Jan. 1966).

The isotopic composition of lead separated from a few whole rock samples of tertiary granites have, except for one sample, yielded model ages greater than the age of intrusion of the host rock, but similar to the age of the local Precambrian basement. The results obtained in this reconnaissance suggest that if a rock is totally remobilized, the lead isotopes can be transferred in a closed, or at least a partially closed chemical system. However, if partial remobilization occurs, or the lead originating from an igneous intrusive phase passes through adjacent rocks, the lead will in all probability have an anomalous character (J-type). Reasonable agreement is obtained between $^{206}Pb/^{204}Pb$, and $^{207}Pb/^{204}Pb$ model ages, while the $^{208}Pb/^{204}Pb$ ages are distinctly lower or negative. (auth)

25312 ON THE PRECISION AND SENSITIVITY OF THE METHOD FOR RADIOGENIC ARGON ASSAYING DEVELOPED AT THE INSTITUTE FOR ATOMIC PHYSICS. Bunescu, L. Stud. Cercet. Fiz., 16: 779-85(1964).

For determining the absolute geologic time by the potassium–argon method, a method was devised for calculation of the concentration of radiogenic argon in the sample. The method used for calculation of the radiogenic argon concentration by means of thermal neutron activation is described. The sensitivity of the method was measured by the minimum amount of ^{40}Ar for which the various degrees of contamination with atmospheric argon may be assayed accurately. Therefore the counting rate errors for ^{37}Ar should be as low as possible. It was found that for a sample with a concentration of 1% potassium, of which only one gram is used in the assay, the minimum age that can be determined is 50 million years. It was inferred from examination of the curves that absolute geologic ages of some ten or hundreds of million years may be assayed with errors within 2 to 3%, and ages of 1 million years may be determined within an accuracy of 10 to 20%. (Rum. Sci. Abstr.)

25313 ESTIMATION OF AGE AND RATE OF MOTION OF GROUND WATER BY THE ^{14}C METHOD. Ingerson, Earl; Pearson, F. J. Jr. (Univ. of Texas, Austin). pp 263-83 of Recent Researches in the Fields of Hydrosphere, Atmosphere and Nuclear Geochemistry. Miyake, Yasuo; Koyama, Tadashiro (eds.). Nagoya, Japan, Sugawara Volume, Nagoya Univ., 1964.

The potential usefulness of a method for direct determination of ages and rates of motion of ground water is discussed. The theory and techniques of the ^{14}C method are given, which could provide direct dates as far back as 50,000 to 60,000 years. A complication rarely encountered in dating organic remains is almost always present in attempts to date ground water, i.e., dilution of the active carbon by dead carbon, which almost always comes from old carbonates, but occasionally from other sources. These sources and the mechanisms by which dilution may be produced are discussed. It is shown that the initial isotopic composition of the carbon in the CO_2 of ground water is determined by that of the CO_2 in the soil air of the intake area, which is quite different from that of atmospheric CO_2, and is probably essentially the same as that of the plants growing in the area. If this isotopic composition can be measured, or estimated, and values can be obtained for those of the carbonate involved in the dilution and of a given water sample, then a correction factor can be applied to the measured radiocarbon content. By use of this correction equation the age of the water sample can be calculated within certain limits. These limits are discussed and evaluated for several hypothetical cases, which probably correspond closely to natural situations. (auth)

25314 RADIOACTIVITY WELL LOGGING FOR DETERMINING THE PRESENCE OF HYDROGEN. McKay, Alexander S.; Hall, Hugh E. Jr. (to Texaco Inc.). U. S. Patent 3,240,937. Mar. 15, 1966. Filed June 14, 1963.

A method and apparatus are described for neutron-gamma well logging of earth formations for hydrogen, a correction being made for interference by chlorine. The apparatus is adapted to be passed through a bore hole and comprises a steel housing containing a source of neutrons and a detector for gamma rays resulting from irradiation of the earth formations. A thin sleeve surrounds at least a portion of the active volume of the detector and is made of a predetermined quantity of a neutron absorbing material characterized by the emission of radiation to which the detector is sensitive. The detector is substantially unshielded with respect to the radiation emitted from the neutron absorbing material. The quantity of the absorbing material is chosen in relation to the intensity and spacing from the source so that the radiation emitted in response to the interaction with neutrons will have an intensity which substantially neutralizes the effect of chlorine. A suitable neutron absorbing material is Cd. (B.L.M.)

25315 RADIOACTIVITY WELL LOGGING FOR DETERMINING THE PRESENCE OF HYDROGEN AND CHLORINE. Hall, Hugh E. Jr. (to Texaco Inc.). U. S. Patent 3,240,938. Mar. 15, 1966. Filed Oct. 14, 1960.

The well logging apparatus described in U. S. Pat. 3,240,937 for the determination of hydrogen in the presence of chlorine in neutron-gamma logging of earth formation is extended to an apparatus including separate gamma and neutron sources that determines both hydrogen and chlorine as well as the density of the formation to indicate whether the hydrocarbon formation is oil or gas. The gamma ray detector combined with the neutron absorbing

material described in the foregoing patent provides the indication of the presence of hydrogen in the presence of chlorine. A second detector positioned from the neutron source is adapted to provide a quantitative signal of the gamma radiation returning to the bore hole as a result of the neutron irradiation and indicative of both the hydrogen and chlorine content. Comparison of these two output signals will yield separate determination of the H and Cl content of the formation. A gamma source is positioned away from the neutron source and the two detectors so as not to influence the detectors. Associated with the gamma source is a detector to indicate the scattering of the gamma radiation from the gamma source by the formation to yield a signal indicative of the formation density. (B.L.M.)

25316 CHLORINE LOGGING SYSTEM USING NEUTRON CAPTURE GAMMA RAYS. Baldwin, Willett F.; Berry, James E. (to Socony Mobil Oil Co., Inc.). U. S. Patent 3,244,882. Apr. 5, 1966. Filed Sept. 25, 1962.

A logging apparatus is provided for logging for chlorine in formations transversed by an iron-cased borehole. The apparatus includes a fast neutron source for irradiating the formations with fast neutrons to produce thermal neutrons and neutron-capture gamma rays, a neutron detector responsive to thermal neutrons for detecting thermal neutrons passing from the formation into the borehole, a gamma ray detector for detecting neutron-capture gamma rays passing from the formation into the borehole, and discriminator means coupled to the gamma ray detector and responsive only to neutron-capture gamma rays detected from an energy range of about 4.6 Mev to an upper limit of somewhat less than 7 Mev to eliminate the high energy capture gamma rays arising from iron. Recording means are coupled to the thermal neutron detector and the discriminating means for recording the intensity of the thermal neutrons detected and the intensity of only the neutron-capture gamma rays within the desired energy range. To prevent the thermalization of neutrons of higher energy, the borehole must be free of all liquids and open to the atmosphere from the surface of the earth to a point below the desired logging depth. The housing of the instrument, at least around the detectors, is formed of nonferrous material to further prevent the interference of neutron-capture gamma rays from iron. (B.L.M.)

Thorium and Uranium Minerals

25317 NEW DATA ON THE DISTRIBUTION OF URANIUM AS A FUNCTION OF THE STRUCTURE OF A GRANITIC MASSIF IN THE MORVAN. Carrat, Henri G. (Centre de Recherches Radiogeologiques, Nancy). Compt. Rend., Ser. D, 262: 1208-11(Mar. 14, 1966). (In French).

The detailed petrographic study of granites of the Luzy massif (meridian Morvan) leads to the individualization of rocks at the interior of which the majority of the deposits and indices of uranium are localized. These results indicate favorable petrographic structures. (tr-auth)

25318 THE SIGNIFICANCE OF Th/U RATIOS CALCULATED FROM WEST-CENTRAL NEW MEXICO MULTISTAGE LEAD DATA. Sinclair, A. J.; Walcott, R. I. (Univ. of British Columbia, Vancouver). Earth Planet. Sci. Lett., 1: 38-41(Jan. 1966).

Th/U ratios were calculated from analyses of multistage leads from west-central New Mexico. They suggest that hydrothermal solutions passing through Precambrian basement rock have selectively extracted lead with a higher $^{208}Pb/^{206}Pb$ ratio than existed in the basement rocks. Contour maps of Th/U ratios seem important in defining regional structural control of solution transport, locating centers of mineralization from which hydrothermal solutions spread, and indicating the direction of solution flow on a regional scale. (auth)

HEALTH AND SAFETY

See *also* BIOLOGY AND MEDICINE — Radiation Hazards and Protection
GEOLOGY, METEOROLOGY, AND MINERALOGY — Natural Radioactivity and Fallout

Refer also to abstracts 25199, 25229, 26430, and 26448.

25319 (CEX–59.4.23) AERORADIOACTIVITY SURVEY AND AREAL GEOLOGY OF PARTS OF OHIO AND INDIANA (ARMS-I). Bates, Robert G. (Geological Survey, Washington, D. C. Division of Biology and Medicine (AEC), Washington, D. C.). June 1964. 19p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

An airborne radioactivity survey was made of an area of 11,250 square miles in central and western Ohio and eastern Indiana. Parallel flight lines were flown in an east-west direction at an interval of one mile and an altitude of 500 ft above the ground. Reactors in the survey area are at West Jefferson, Dayton, Columbus, and Piqua, Ohio. Little geologic information was obtained from the radioactivity data. The majority of the survey area has been glaciated and almost all of the area is covered by deposits of till, outwash, or loess. The interlobate area formed between the Miami and Scioto glacial lobes during late Wisconsin time is outlined by a radioactivity low. Two exposures of Ohio Shale north of Columbus, Ohio, are outlined by radioactivity highs. (P.C.H.)

25320 (IDO–12051) AIRBORNE PARTICLE SIZE ANALYSIS. A Composite Bibliography. Collins, J. T. Jr.; Harrie, W. J.; Stromberg, D. D.; Powers, J. L. (Idaho Operations Office (AEC), Idaho Falls. Health and Safety Div.). May 1966. 37p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

References (325) are given to reports and journals published from approximately 1841 through 1965. The topics considered include: aerosol behavior and characteristics; aerosol generation; autoradiography; determination of particle size; and instrumentation for collection and separation. (P.C.H.)

25321 (NP–16036) RADIOACTIVITY SURVEY DATA IN JAPAN. Number 7. (National Inst. of Radiological Sciences, Chiba (Japan)). May 1965. 37p. Dep. mn.

Data are tabulated for: ^{90}Sr and ^{137}Cs in rain water and fallout dust; ^{90}Sr, ^{137}Cs, and ^{144}Ce in air; ^{90}Sr and ^{137}Cs in milk and total diet; ^{90}Sr in human bone; ^{137}Cs in human body; chemical composition of fallout; gross beta activity and activity of radioiodine in rain and dry fallout; gross beta activity in upper air; and ^{131}I in milk. The dates covered are given for each table. (P.C.H.)

25322 (ORNL-NSIC–11) 1965 COMPILATION OF UNITED STATES NUCLEAR STANDARDS. 2nd Edition, 1965. Cottrell, Wm. B. (Oak Ridge National Lab., Tenn.). Dec. 1965. Contract W-7405-eng-26. 94p. Dep. mn. CFSTI $4.00 cy, $0.75 mn.

All United States nuclear standards activities and regulations known to this committee are presented in simple tabular form. The standards activities of all organizations including technical societies, as well as relevant regulations established by government agencies, are listed in alphabetical order by organization, etc. in instances where that organization itself undertakes the development of nuclear standards. Included as an appendix is a special report on the transportation of radioactive materials. This appendix attempts to identify the pertinent criteria and/or regulations for the transportation of various forms of radioactive substances by any of the several transportation media. (M.O.W.)

25323 (SC-R–66-865) CLEANLINESS METER AND ITS APPLICATION TO SOLVENT CLEANING. Marsh, R. C.; Oswalt, F. W. (Sandia Corp., Albuquerque, N. Mex.). Mar. 1966. Contract AT(29-1)-789. 26p. (SC-DC–66-1414; CONF-660316–1). Dep. mn. CFSTI $2.00 cy, $0.50 mn.

From AACC 5th Annual Technical Meeting and Exhibit, Houston, Tex.

The development and application of a new instrument which will measure the soluble residue content of volatile cleaning solvents is described. The instrument, called the Solvent Purity Meter, is capable of giving an instantaneous and continuous read-out of residues as low as 1 ppM and may be used either for batch sampling or as an on-line continuous monitor for recirculating cleaning systems. Typical laboratory studies using the meter, as well as results from in-process cleanliness testing applications on component production lines, are discussed. Evaluations of the instrument, to date, showed it to be a useful production line monitor for testing the purity of cleaning solvents, as an indirect measure of component cleanliness, and for pointing out errors or problem areas when troubleshooting component cleaning problems. (auth)

25324 (TID–16764(Suppl.2)) A SUMMARY OF INCIDENTS INVOLVING USAEC SHIPMENTS OF RADIOACTIVE MATERIAL, 1963–64. (Division of Operational Safety (AEC), Washington, D. C. Industrial Safety and Fire Protection Branch). Apr. 1966. 23p. Dep. mn. GPO $0.20.

Information pertaining to incidents sustained by the AEC in the transportation of radioactive materials during the period from January 1, 1963, through December 31, 1964, is presented. In the period covered, there were twenty-four incidents reported. Thirteen (54%) of the twenty-four incidents did not result in release of radioactive materials. Of the remaining eleven cases, which did involve radiation releases, six were limited to the carrier vehicle and only one involved costly cleanup. Of the twenty-four incidents reported, only one involved impact damage to the shipping container while the vehicles involved suffered damage ranging from none to total destruction. The incidents are classified in accordance with the scheme used in TID-16764. (P.C.H.)

25325 PROPOSED INTERNATIONAL ATOMIC ENERGY AGENCY REGULATIONS FOR THE INTERNATIONAL TRANSPORT OF FISSIONABLE MATERIALS. Wachter, J. W. (Union Carbide Nuclear Co., Oak Ridge, Tenn.). Chem. Eng. Progr., 61: Symp. Ser. No. 60, 70-6(1965).

The proposed International Atomic Energy Agency regulations for the international transport of fissile materials are discussed with respect both to the basic nuclear safety considerations involved in transporting or storing such material, and also to the application of such rules to common carrier shipments. (auth)

25326 METHOD OF RADIOMETRIC CONTROL OF RADIOACTIVE CONTAMINATION OF MOIST WORKING SURFACES. Korenkov, I. P.; Golikov, V. Ya. (First Moscow Order of Lenin Medical Inst.). Gig. Sanit., 2: 54-6(Feb. 1966). (In Russian).

The α emitters, which represent the chief potential source for incorporation of highly toxic radioisotopes, were found to settle on exposed surfaces, forming three physically distinct layers: a loose, easily removable layer, a slightly bound layer that must be treated with special decontaminating agents and a strongly bound layer that can be removed only by removing the material composing the layer. The loose layer presents the great-

est hazard because it can be easily transferred to the hands and the clothing of the workers. It was proposed that smooth or impermeable surfaces be dried by heating with an infrared lamp placed 5 to 7 cm from them; the degree of dryness may be determined by means of a hygrometer. It was also found that the count rate involving material collected from porous surfaces, such as wood, decreased by 25% when the humidity increased from 0 to 24%. By taking this effect into account, the contamination of porous materials may be calculated without complete drying of the test surface. (TTT)

25327 THE DETERMINATION OF ^{32}P IN URINE AND THE EVALUATION OF THE FINDINGS FOR THE ASSESSMENT OF INTERNAL CONTAMINATION. **Eakins, J. D. (Atomic Energy Research Establishment, Harwell, Eng.); Gomm, P. J.; Jackson, S. Health Phys., 12: 593-603 (May 1966).**

A method for the determination of total ^{32}P by direct beta-counting of urine is described, together with more sensitive radiochemical procedures for total ^{32}P and for ^{32}P as inorganic phosphate. The interpretation of the results as a measure of internal contamination is fully discussed, with particular reference to the program of urine sampling at the Radiochemical Centre of the U. K. Atomic Energy Authority at Amersham. (auth)

25328 DETERMINATION OF ^{32}P IN VIVO. **Palmer, H. E. (Pacific Northwest Lab., Richland, Wash.). Health Phys., 12: 605-8 (May 1966). (BNWL-SA-198).**

A transmission proportional counter and a NaI(Tl) scintillator, operated in coincidence for detection of ^{32}P beta rays emitted from the head, is better for in vivo measurements than a bremsstrahlung counter. The background is lower and is much less variable from person to person. Relatively little shielding is required. The ^{32}P body burdens of people who eat whitefish from the Columbia River near Hanford can be measured by this method. (auth)

25329 DEPTH-DOSE DATA FOR PROTONS AND PIONS FROM 1.0 TO 10.0 Bev/c. **Wheeler, Robert V. (Argonne National Lab., Ill.). Health Phys., 12: 653-61 (May 1966).**

Data were collected to determine dose build-up in tissue resulting from beams of high energy protons and pions. Using the external momentum-analyzed beams of the Argonne 12.5 Bev Zero Gradient Synchrotron, depth-dose measurements were made in beams of positive particles with momenta of 1.0, 1.5, 2.5, 4.0, 5.0 and 10.0 Bev/c; and in beams of negative particles with momenta of 1.0, 1.5, 2.0, 3.0, 4.0 and 5.0 Bev/c. Measurements were made using a tissue-equivalent integrating ionization chamber. These measurements were normalized to a graphite integrating ionization chamber beam monitor. Data were collected at 1-in. intervals through a 10-in. thick Plexiglas phantom. The resulting depth-doses were normalized to the entrance dose for each momentum. Results show that in both the positive and negative beams the dose build-up factors decreased within the momenta range from 1.0 Bev/c to about 2.0 Bev/c, but then increased with higher momenta. For a given particle momentum, the dose build-up factor in the negative beams exceeded that obtained in the positive beams. At 5.0 Bev/c, a maximum build-up factor of 1.45 was obtained with negative particles as opposed to a build-up factor of 1.19 with positive particles. The results of this study are discussed in terms of values of stopping power for protons and pions in the Bev region, proton-pion ratios, muon contamination, cross-section data and production of cascade particles. (auth)

25330 PLUTONIUM IN NUCLEAR REACTORS. Part II. **Bucci, P. Ing. Nucl., 6: 307-19 (Nov.-Dec. 1965). (In Italian).**

The physical safety parameters in handling Pu, especially in large fast reactors using ceramic oxide fuels, are discussed. The ceramic fuels themselves, as well as the safety problems in the working of Pu are also discussed. (G.O.Y.)

25331 DOSIMETRY IN THE VICINITY OF INTERFACES IN RADIOBIOLOGICAL EXPERIMENTS WITH HIGH-ENERGY X AND γ RAYS. **Dutreix, J. (Institut Gustave-Roussy, Villejuif, France); Bernard, M. Int. J. Radiat. Biol., 10: 177-81 (Feb. 28, 1966). (In French).**

The absorbed dose in a water-equivalent medium irradiated in contact with a wall of different atomic composition experiences a rapid variation in the vicinity of the interface. From ionization measurements in carbon, the dose was derived for the interfaces between water and different usual walls (glass and plastic materials) exposed to high energy γ- and x-rays. The case of a thin slab of water between two walls was investigated. (auth)

25332 INVESTIGATION OF FUEL ELEMENT TEMPERATURES IN CHAPELCROSS DISCHARGE VESSELS AND TRANSPORT FLASKS. **Whittle, D. (Dominion Tar and Chemical Co., Ltd., Canada); Anderson, D. J. Brit. Nucl. Energy Soc., 5: 156-64 (Apr. 1966).**

Steady state temperature measurements have been made in the vessels used at the UKAEA, Chapelcross Works, for the discharge and transport of fuel elements. These measurements have been used to calculate the maximum temperature to which an irradiated fuel element is heated when placed in a discharge vessel and to calculate the maximum temperature to which the interior of a water filled transport flask would be heated when used during hot summer weather. Experimental and data analysis techniques which can have general application to similar problems are illustrated. Models for the wet and dry transport flasks are described, permitting predictions to be made of specific temperature conditions which were in excellent agreement with measured temperatures. (auth)

25333 CONTAMINATION OF FOOD-STUFFS WITH RADIOACTIVE FALLOUT AT FUKUOKA DISTRICTS. **Morishige, Toshiko (Kyushu Univ., Japan). Jap. J. Hygiene, 20: 58-64 (June 1965). (In Japanese).**

The seasonal variations of gross counts of the radioactive substances in fallout deposited on standard foods recommended by the National Laboratory of Dietetics for normal adult Japanese are reported. Gross counts of the radioactive substances on leaf vegetables decreased continuously since November 1961. Gross counts of the radioactive substances on leaf vegetables and that contained in the vegetable itself varied seasonally, i.e., increased in winter, decreased gradually until autumn, and then increased again in winter. Remarkable seasonal variations on the gross counts of radioactive substances in raw milk and pasteurized milk were not observed, but a little lower counts were observed in Jan. and Feb. Higher gross counts of radioactive substances were observed in perennial fruits such as pear and grape than in watermelon and annual fruits. Gross counts of the radioactive substances in shortnecked clam increased in May and June, but the value decreased gradually until winter and were lowest in Jan. and Feb. The ^{137}Cs was found in all materials by a nuclear analysis of radioactive substances. (auth)

25334 SOME CONSIDERATIONS ON DOSIMETRIC MEASUREMENTS WITH CYLINDRICAL IONIZATION CHAMBERS. **Belletti, S. (Spedali Civili, Brescia). Nunt. Radiol., 31: 937-43 (Sept. 1965). (In Italian).**

The limited dimensions of a cylindrical ionization chamber pose the problem of the exact definition of the point to which measurements must be referred. Some curves obtained with an ionimetric probe are reported and compared with similar curves obtained by means of an extrapolation ionization chamber. The comparison of the curves gives the displacement of the measurement point with respect to the central axis of the probe. This displacement proves to be, for the chamber and for the radiation fields used, about $\frac{1}{3}$ to $\frac{1}{4}$ of the diameter of the measurement volume. (auth)

25335 HUMAN BODY DOSES FROM NATURAL RADIOACTIVITIES. **Tajima, Eizo (St. Paul's Univ., Tokyo). Radioisotopes (Tokyo), 14: 335-42 (July 1965). (In Japanese).**

Human-body doses from natural radioactivities from the following sources are described in detail: (1) external radiations (cosmic rays and ground radiations); (2) ^{222}Rn, ^{220}Rn, etc., in the atmosphere; (3) radioactive carbon; and (4) natural radioactive substances in the internal organs (^{40}K, ^{14}C, ^{3}H, ^{226}Ra, ^{210}Pb, ^{210m}Bi, and ^{210}Po). (tr-auth)

25336 ON THE AGE-CONDITIONED RADIATION SENSITIVITY OF WHITE RATS. I. IRRADIATION ARRANGEMENT AND DETERMINATION OF TISSUE DOSE. Reincke, Ursula; Mellmann, Juergen; Rother, Mechthildis (Univ., Freiburg i. B.). Strahlentherapie, 129: 622-8 (Apr. 1966). (In German).

Whole-body irradiation with 200 kv x rays was done in rats on both sides using a compensating Al filter. Under these conditions, 6 to 8% uniform dose distributions could be obtained. The tissue dose was measured in 12, 24, 32, and 200 day old rats, and the absorbed dose in rads was estimated. (auth)

25337 A METHOD OF FILM DECONTAMINATION OF RADIOACTIVELY CONTAMINATED SURFACES. Robev, St.; Sumerska, T.; Todorov, S.; Kristanov, D.; Marinova, Ts. (Inst. of Radiology and Radiation Hygiene, Sofia). Vienna, International Atomic Energy Agency, 1965, Preprint No. SM-71/2, 10p. (In Russian). (CONF-651202-35). ORAU.

From Symposium on Practices in the Treatment of Low and Intermediate Level Radioactive Waste, Vienna.

A new method of preliminary treatment of contaminated surfaces is reported. The essence of this method is the use of hydrophilic, setting, colloidal solutions, which, after wetting of the surface, form an elastic film that can be easily removed, taking with it the radioactive contamination. The basic composition is as follows: 2–10% polyvinyl alcohol in water, 1% EDTA, 15–20% ethyl alcohol, 0.02% sodium carbonate. The effectiveness of the method, in terms of percentage deactivation, ranges from 52% for ^{32}P on wood to 99% for ^{59}Fe on a polished polyvinyl chloride surface. The compound is applied to the surface with a brush or an aerosol spray. The method can be used for activity ranges up to 1 mC per square decacentimeter. Initial studies showed that in some cases the proposed decontamination compound can also be used for skin surfaces. The method can be used in radiochemical laboratories for decontamination of boxes, fume cupboards, etc. (auth)

25338 FLEXIBLE SHIELD FOR IONIZING RADIATIONS. Weinberger, Jan V. (to Gentex Corp.). U. S. Patent 3,239,669. Mar. 8, 1966. Filed Nov. 25, 1960.

A flexible shield for ionizing radiation is composed of a barrier layer of 98.5% powdered Pb, 1.0% silicone rubber, and 0.5% of fiber flock sandwiched between two fabric layers by means of an adhesive. One of the fabric layers may be a heat resistant cloth. If more shielding is needed, several barrier layers may be sandwiched together between the fabric layers. The shield gives excellent x-ray absorption and yet is flexible enough to conform to the contours of the body when aprons or shields for x-ray analysis or therapy are needed. (B.L.M.)

INSTRUMENTATION

General

Refer also to abstracts 26095, 26396, and 26546.

25339 (AERE-R-5097, Paper 9) A WIDE ANGLE TARGET SYSTEM FOR ANGULAR CORRELATION MEASUREMENTS. Smith, P. B. (Groningen Rijksuniversiteit (Netherlands)). 6p.

The target system described has the following characteristics: absence of organic materials, possibility of good cooling, essentially isotropic absorption over a range of polar angles from −5 to 128° on the front side and from 55 to 140° on the back side, and precision centering of the target material with respect to counters. A detailed construction drawing and views of the target holder, the beam-limiting diaphragm, and rotatable insulated vacuum seal are included. Curves also show results of measurements made with a ^{137}Cs source at the center of a target blank on both the front and the back of the target. (A.G.W.)

25340 (AERE-R-5097, Paper 24) A CRITICAL SURVEY OF METHODS FOR DETERMINATION OF FILM THICKNESS APPLICABLE TO NUCLEAR TARGETS. Howe, F. A. (Atomic Weapons Research Establishment, Aldermaston (England)). 5p.

The following devices used for weight determination of stable isotopic and natural targets are briefly surveyed: balance weighing, α-particle thickness monitor, modulated beam photometer, densitometer, crystal thickness monitor, dynamic balance, and vapor beam ratemeter. Each device is discussed briefly, and a table shows measurement capacity, accuracy, and approximate cost of each. (A.G.W.)

25341 (AERE-R-5097, Paper 25) THICKNESS MEASUREMENT AND MASS DETERMINATION OF EVAPORATED LAYERS. Moret, H. (European Atomic Energy Community, Geel (Belgium). Central Nuclear Measurements Bureau). 7p.

A short survey of the most commonly used methods of thickness measurement is presented, with emphasis on methods used in Euratom. Methods described briefly include pneumatic measurement, mechanical capacitive pickup, absorption of α particles, densitometry, and direct weighing. (A.G.W.)

25342 (AERE-R-5097, Paper 26) THICKNESS MEASUREMENT AND TARGET UNIFORMITY STUDIES. Kobisk, E. H. (Oak Ridge National Lab., Tenn.). 3p.

Thickness measurements employed by target fabricators are discussed with regard to the physical characteristic actually being measured and the significance of the measurement to the physicist using the target. The need for defining films as to atom count and crystal orientation is pointed out. Development work on production of more uniform films and techniques for making more meaningful measurements is mentioned briefly. (A.G.W.)

25343 (HASL-66-4) SINGLE-CHANNEL ANALYZER: HASL TYPE TM-41. Freeswick, D. C.; Graveson, R. T. (Health and Safety Lab., New York Operations Office (AEC), N. Y.). Apr. 4, 1966. 41p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

For Engineering Drawings see CAPE-1424.

A single channel analyzer is described in detail. Specifications, general description, operational description, internal adjustments, and circuit descriptions are given. (M.O.W.)

25344 (INR-639/III/E) ANALIZA I SYNTEZA UKLADU DO STABILIZACJI PRADU, ZASILAJACEGO ELEKTROMAGNES, Z AMPLIDYNA JAKO ZRODLEM PRADU ORAZ ODSPRZEZENIEM REZONANSOWYM W STOPNIU KONCOWYM WZMACNIACZA. (Analysis and Synthesis of the System for the Electromagnet Current Stabilization with the Amplidyne as the Source of Current and the Selective Feedback Circuit in the Last Stage of the Amplifier). Burzynski, Zygmunt (Institute of Nuclear Research, Warsaw (Poland)). 1965. 77p. Dep.

It is shown that the electromagnet current stabilization circuits with the amplidyne as the source of current and the chopper voltage error amplifier, need the synthesis for the used amplifications on the basis of the required stabilization. The synthesis depends on theoretical determination from the transmittance of corrected open circuit, the selective feedback parameters in the last stage of the amplifier, in order to receive the stabilized loop without essential reduction of the frequency band passed by the open circuit. The general form of the open system transfer function is given in the factored form. To simplify interpretation of logarithmic diagrams all factors are of first and second order. The Nyquist diagrams of circuit performance are given for the circuit before and after correction. Owing to very low sensitivity threshold and high amplification of the voltage error amplifier, determination of the amplitude—phase characteristics is made on the basis of input-output time oscillograms. Experimental Nyquist diagrams confirm validity of the theoretical synthesis. Oscillograms of the transient response for the closed system confirm efficiency of the selective feedback circuit in the last stage of the amplifier. On the basis of this theory of analysis and synthesis several current stabilizers for β spectrometers and magnetic analyzers were built in the Institute of Nuclear Research. (auth)

25345 (SC-DC-66-1491) ORGANIZATION AND MANAGEMENT OF A STANDARDS AND CALIBRATION PROGRAM FOR A RESEARCH AND DEVELOPMENT LABORATORY. Schneider, R. L. (Sandia Corp., Albuquerque, N. Mex.). Apr. 1966. Contract AT(29-1)-789. 10p. (CONF-660522-1). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From National Conference of Standards Labs., Annual Meeting, Gaithersburg, Md.

A measurement standards and instrument calibration program for a research and development laboratory is described. The description of this program deals primarily with the organizational philosophy of the system and does not delve into the technical aspects of standards or instrument calibration. (M.O.W.)

25346 (SC-R-66-871) SURFACE PLATE GAGING. Roth, E. S. (Sandia Corp., Albuquerque, N. Mex.). Apr. 1966. Contract AT(29-1)-789. 11p. (CONF-660319-2). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From American Society for Metals Sessions, WESTEC Conference, Los Angeles.

Surface plate gage setups that are compatible with dimensioning and tolerancing standards when MMC (Maximum Material Condition) callouts are specified and illustrated. These methods are especially useful for evaluating initial production parts when functional gages are not yet available, and can be constructed to reflect wear and gage tolerances, if desired. (P.C.H.)

25347 BRIDGE CIRCUIT FOR HIGH-SENSITIVITY PHASE MEASUREMENTS AS BASIS FOR MEASUREMENT OF PHYSICAL QUANTITIES WITH COUNTERS. Kroebel, W. Atomkernenergie, 11: 205-9(May-June 1966). (In German).

A bridge circuit for phase measurements is described, which can provide a very high rate of phase change for a given change of a resistance or reactance. A phase change of one degree can be obtained for relative resistance changes of 10^{-5} to 10^{-6}. The phase bridge can also be used to add the results of a number of different measuring elements and thus averages of physical quantities (e.g., temperature) over given volumes can be formed. The bridge circuit was tested for temperature measurements with NTC resistors. The results can be obtained both in analog and in digital form. (auth)

25348 NUCLEAR INSTRUMENTATION. NO. 24. Bull. Inform. Sci. Tech. (Paris), No. 102, Suppl., 1-51 (Mar. 1966). (In French).

The design and specifications of the amplifiers, functional elements, counting or analysis installations, reactor electronics, and radiation detection instruments recently developed by the C. E. A. are reported. The devices described include a transistorized vibrating condenser electrometer, spectrum stabilizer, period meter, automatic water collector for monitoring studies, and an oscilloscope. (J.S.R.)

25349 USE OF DOUBLE-FOCUSING ELECTROMAGNETIC LENSES FOR MICROELECTRON DIFFRACTION PATTERN PROJECTION. Vorona, Yu. M.; Vertsner, V. N. Dokl. Akad. Nauk SSSR, 165: 61-2(Nov. 1, 1965). (In Russian).

Conventional methods of electron microscopy utilize intermediate lens for the projection of enlarged images of the object or of its diffraction pattern. It is shown that a more detailed analysis of the properties of the condenser-objective lens makes the projection of enlarged electron diffractions possible without the introduction of an intermediate lens. Usually, the objective lens of an electron microscope forms, near the second focal point, a reduced image of the source of electrons. By increasing the excitation of the lens, this image plane moves toward the center of the lens and at a certain point double focusing of the electron beam is achieved by the single objective lens. The first section of the lens field produces a reduced image of the cathode at a spot which is near the maximum of the field, and the second section of the field carries out the magnification. If an object is placed above the plane of the first image of the electron source, the plane then contains the desired diffraction pattern which is then magnified by the second part of the field of the objective lens. Questions of resolution and magnification of the newly proposed approach are discussed and the favorable results obtained on a test setup designed in a standard EM-5 electron microscope are described. (ATD)

25350 DESIGN FEATURES OF A START-STOP TIME-TO-AMPLITUDE CONVERTER. Henebry, W. M.; Rasiel, A. (EG and G, Inc., Salem, Mass.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci., NS-13: 64-8(Apr. 1966).

A time-to-amplitude converter of the start-stop type is described. Automatic suppression of readout in the absence of a timely stop signal and an analog memory, which permits delay of readout to allow independent evaluation of a conversion, are two of its several novel design features. With full scale ranges of 0.1 to 30 μsec, the instrument provides good linearity, stability and resolution over a wide range of operational conditions. (auth)

25351 SOME HIGH VOLTAGE PULSE TECHNIQUES IN USE AT ARGONNE. Lewis, R. N.; Jung, E. A.; Chapman, G. L.; Van Loon, L. S.; Romanowski, T. A. (Argonne National Lab., Ill.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci., NS-13: 84-8(Apr. 1966).

Instrumentation requirements at Argonne have necessitated the development of circuits capable of delivering megawatt-level pulses into various types of loads. The allowed delay time between the command signal and the output pulse has ranged from a few nanoseconds to a few microseconds and the allowed time jitter has generally been in the low nanosecond region. Some of the components and circuits and some of the system design concepts in current use at Argonne for high voltage-high current pulse instrumentation are discussed. (auth)

25352 PERFORATED TAPE RECORDER FOR DIGITAL SCAN DATA STORE WITH GREY SHADE AND NUMERIC READOUT. Kuhl, David E.; Edwards, Roy Q. (Univ. of Pennsylvania, Philadelphia. William H. Donner Center for Radiology, Philadelphia). J. Nucl. Med., 7: 269-80(Apr. 1966).

The design and operation of a scan data system is described. Digitized counting and position data are recorded on a strip of perforated paper tape without significant loss or distortion. Rapid playback converts these data to a recognizable form. For visual inspection, a grey shade picture is generated on Polaroid film, with contrast under operator control. For quantitative retrieval, the counting data are presented as a matrix of typewritten numbers. The inexpensive length of perforated paper tape remains part of the patient's permanent record, available for future analysis if needed. Instrument cost is commensurate with present day rectilinear scanners. The data system has proved to be efficient and reliable in the processing of several thousand scans over the past two years. (auth)

25353 DISTORTION OF PEAK SHAPE IN FAST SCANNING OF MASS SPECTRA. Banner, A. E. (Associated Electrical Industries, Ltd., Manchester, Eng.). J. Sci. Instrum., 43: 138-40(Mar. 1966).

When a mass spectrometer is operated under fast scanning conditions the apparent resolving power and sensitivity as exhibited on a recorded spectrum are, in general, less than the static values, due to the limited bandwidth of the recording system. The present paper offers a theoretical treatment of the problem, the variation of these characteristics with scan time and time constant of the recording system being derived for various values of static resolution. Results have been computed from the theory, assuming a triangular peak shape under slow scan conditions, and a comparison is made with experimental observations both on a single and on double focusing instrument. Good agreement is obtained. (auth)

25354 EXCESS ENERGY MEASUREMENT OF ION BEAM FROM HIGH FREQUENCY ION SOURCE. Tsuchimoto, Takashi (Hitachi Central Research Lab., Tokyo). Jap. J. Appl. Phys., 5: 327-32(Apr. 1966).

The excess energy of an ion beam from a h-f ion source was measured by using an h-f ion source with mesh grid. The ion source was operated using unusual electric connections. The results suggest that the excess energy is due to the increase of plasma potential caused by energetic electrons. By the use of an electric shielding screen, it is shown that the axial component of the electric field from the high frequency coil is only a fractional source of the excess energy. (auth)

25355 ANALYSIS, CALCULATIONS AND MEASUREMENTS CONCERNING THE MOISTURE MEASURING BY THE NEUTRON METHOD. Kasi, S.; Koskinen, H. (Inst. of Tech., Otaniemi, Finland). Nucl. Eng. Design, 3: 74-82 (Jan. 1966).

A method of numerical analysis for the moisture measurement with neutrons, with special consideration of the effects of the dry density and the possible boron content of the material is described. Then a series of measurements performed by using an instrument including an additional iron reflector are reported and the results analyzed. Finally some theoretical approaches of a more analytical nature are illustrated by applying simple physical models. Special attention is paid to the influence of a nonuniform distribution of moisture on the mathematical treatment. (auth)

25356 SUPERCONDUCTING GALVANOMETER EMPLOYING JOSEPHSON TUNNELLING. Clarke, J. (Cambridge Univ., Eng.). Phil. Mag. (8), 13: 115-27(Jan. 1966).

The phenomenon of Josephson tunnelling was applied to the detection of low voltages at liquid helium temperatures. A new technique for the manufacture of specimens displaying double-junction characteristics was developed, and a theory for their behavior suggested. The junctions were used in a practical voltmeter to achieve a sensitivity of 10^{-14} v with a time constant of 1 sec; the sensitivity may be extended indefinitely for a proportionate increase in the time constant. (auth)

25357 FAST RESPONSE PICOAMMETER. Presley, Samuel P. (Univ. of California, Berkeley). Rev. Sci. Instrum., 37: 643-8(May 1966). (UCRL-16171).

A fast response picoammeter design incorporating a

commercially available transistorized differential amplifier is described. The input circuit uses three transistors and one electrometer tube and has unique features. A guard signal is provided for the reduction of input cable capacitance. Problems associated with large range resistances are discussed. (auth)

25358 ULTRASENSITIVE AMPLIFIER FOR MASS SPECTROMETRY USE. Altman, Carl; Peek, Levin J. (Western Electric Engineering Research Center, Princeton, N. J.). Rev. Sci. Instrum., 37: 663-4(May 1966).

An amplifier that was developed to permit the use of an oscilloscope or strip chart recorder with a mass spectrometer is described. (D.C.W.)

25359 THE BELL LABORATORIES MOESSBAUER EFFECT DOPPLER MODULATOR. Wertheim, G. K.; Cohen, R. L. (Bell Telephone Labs., Murray Hill, N. J.). pp 48-52 of STI-DOC-10/50.

A device that is designed to shift the energy of a nuclear gamma ray by a precisely controlled amount is described. (D.C.W.)

25360 MAGNETIC TAPE SYSTEM FOR DIGITAL PROCESSING OF MULTIPARAMETER NUCLEAR RADIATION SPECTRA. Waibel, Eberhard (Physikalisch-Technische Bundesanstalt, Brunswick). Z. Angew. Phys., 20: 442-8(Apr. 1966). (In German).

Electronic equipment was developed to record multiparameter nuclear spectra of several detectors on magnetic tape in digital mode and to reproduce the digitized spectra from tape to the memory of a conventional multichannel pulse-height analyzer. In reproduction the spectra can be read singly with coincidence conditions, simultaneously in multiplex operation, coincident to a window of any width and location of a second spectrum, and in two-parameter representation with any beginning of partial matrices. All operations are purely digital. The preprocessed data may be fed by punched tape directly to an electronic computer. (auth)

25361 MEASUREMENT OF THICKNESS AND DENSITY WITH β RAYS. Sitzler, H.-D. Karlsruhe, Ger., Technische Hochschule, 1965. 97p. $2.00 Gmelin, AED-Diss. 65-235.

Methods for measuring oil film thicknesses in bearings were investigated. Design and construction of a probe for β absorption and backscatter measurements with a semiconductor are described. A system for determination of periodical thickness changes that occur in bearings is described using a multichannel analyzer with an angle-to-channel converter. (Gmelin Inst.)

25362 GENERAL PURPOSE LOW VOLTAGE POWER SUPPLY /Q-2543/ (Engineering Materials). (Oak Ridge National Lab., Tenn.). (CAPE-1332).

1 drawing.

The power supply described can be adapted to the requirements of the majority of general purpose instruments used at the Oak Ridge National Laboratory. The components are assembled on a small etched board. Lists of components are included for constructing any one of 24 supplies having an outing voltage in the range of 24 to 6 v (either positive or negative) and a current limiting capacity of either 100 or 300 ma. Each supply is adjustable to ±2 v. Line and load regulation is within 0.5% and ripple is 2 mv. The current limiter can be set at any convenient level, and the circuit will limit at this current level under a short-circuit condition for an unlimited time. (For details, see TID-4100). (M.C.G.)

25363 PRECISION PYROMETER, CMB-3 (Engineering Materials). (Los Alamos Scientific Lab., Univ. of California, N. Mex.). (CAPE-1331).

5 drawings.

A photo-counting pyrometer is capable of measuring radiation with high precision in a temperature range from 1,000 to 4,000°C. A stable, precision, photoelectric counter measures the radiation passing through a 0.004 in. or smaller field stop at the image of the pyrometric field under study. The system is very stable, and the reference lamp filament can be eliminated after initial calibration. The main sections of the pyrometer are the optics, reference filament circuitry, photomultiplier and power supply, and the pulse amplifier and counter. The photomultiplier and circuitry have low pulse background and noise, the counting electronics are of high stability, and the equipment has a high counting rate capability. (For details, see TID-4100). (M.C.G.)

25364 A PROCESS FOR THE REGENERATION AND ACTIVATION OF RADIOACTIVE LUMINOPHORES. (to Ceskoslovenska Akademie Ved). British Patent 1,022,582. Mar. 16, 1966. Priority date June 11, 1962, Czechoslovakia.

In a process for the regeneration and activation of aged radioactive luminophors the luminophor and a radioactive salt are subjected to heat treatment, preferably from 1000° to 150°C in a period of 3 to 300 min. The process may be repeated several times, and further aging of the reactivated luminophor does not progress at a rate any greater than before. (B.L.M.)

25365 IMPROVEMENTS IN OR RELATING TO PULSE GENERATORS. Kandiah, Kirthirkamathamby (to United Kingdom Atomic Energy Authority). British Patent 1,025,331. Apr. 6, 1966. Filed Apr. 7, 1961.

A pulse generator with a stable mean repetition frequency and with an amplitude which is swept linearly with time over the required range is described for particular application for checking the channel width uniformity of multichannel pulse analyzers. The generator includes a d-c amplifier for generating a triangular voltage waveform having linear positive-going and negative-going sweeps. The amplifier has a capacitor connected between the input and output and a first resistor connected between the input and a point whose polarity with respect to the input is reversed by electronic switch means operated by the amplifier output at the most negative and most positive limits of the triangular waveform. Pulse generating means are provided whose repetition period is short compared with the duration of the sweeps that is adapted to derive from the waveform a train of pulses whose amplitudes are defined by the instantaneous amplitude of the waveform. Detailed description of all components is given. (B.L.M.)

25366 TEMPERATURE COMPENSATED CONDENSATION PRESSURE ANALYZER. Pappas, W. D. (to U. S. Atomic Energy Commission). U. S. Patent 3,234,780. Feb. 15, 1966.

A device which is immune to temperature changes for continuously monitoring the concentration of uranium hexafluoride in a process line which contains gaseous contaminants and regulating the flow through the line in accordance with such concentration is described. (AEC)

25367 TIRE PRESSURE DETECTOR AND INDICATOR SYSTEM USING RADIOACTIVITY. Haller, Alton P. U. S. Patent 3,235,726. Feb. 15, 1966. Filed July 12, 1962.

An apparatus is provided for detecting and indicating the fluid pressure in a fluid chamber, particularly to detect and indicate reduced pressure in vehicle tires. A radioisotope is used to produce a signal to show the amount of fluid pressure in the chamber. A radioactivity shield is positioned between the radioactive material and the radioactivity detector. The reduction of the fluid pressure in the chamber permits relative movement between the radioactive material and the shield in an amount related to the reduced pressure. The rays emitted from the source activate the detector to produce an output signal which triggers indicators showing the reduction of pressure in the chambers. The apparatus is highly reliable, maintenance free, and easily installed in existing vehicles such as trucks and buses. (B.L.M.)

25368 VELOCITY MEASUREMENT UTILIZING NEUTRON ACTIVATION OF OXYGEN. Oshry, Howard I.; Youmans, Arthur H. (to Dresser Industries, Inc.). U. S. Patent 3,239,663. Mar. 8, 1966. Filed Dec. 4, 1961.

A method for measuring relative movement between a fluid and a sensing station within the fluid is described with particular reference to the measuring of the speed and direction of movement of a submarine or boat through the water without the production of extraneous signals or modification of physical conditions beyond the locale of the point of measurement. A high energy neutron source is mounted inside the hull of the vessel below the water line and preferably near the bow. Collimating means are provided for directing the neutrons from the source in a narrow beam extending from the hull of the vessel in order to excite oxygen nuclei in the water spaced from the hull as well as in the sheath of water that is frictionally drawn along the hull. Collimated detector means supported inside the hull aft of the source detect the excited oxygen nuclei outside the hull. Means are provided for measuring the response of the detector means in order to indicate the velocity with which the vessel travels. (B.L.M.)

25369 FROST-ICE DETECTOR UTILIZING A RADIOACTIVE SOURCE AND DETECTOR. Goldman, Howard J.; Wayne, Harry A. U. S. Patent 3,239,668. Mar. 8, 1966. Filed Mar. 2, 1964.

An apparatus is described for selectively detecting and indicating conductive and nonconductive thin surface deposits, such as frost, water, or ice on highway surfaces. The apparatus combines an electrically conductive circuit for detecting conductive deposits with a nuclear radiation circuit for detecting nonconductive deposits. (B.L.M.)

25370 MEASUREMENT OF ELECTRIC AND MAGNETIC FIELDS BY BACKSCATTERING OF NUCLEAR RADIATION PARTICLES. Varner, Donald E. (to Industrial Nucleonics Corp.). U. S. Patent 3,240,939. Mar. 15, 1966. Filed May 5, 1961.

Means are provided for detecting the effect of a field to be measured, either magnetic or electric, on beta particles passing between a radioactive source and a detector. The source and detector are so positioned with respect to each other that in the absence of a field to be measured, the particles from the source move almost directly away from the detector. When a field is to be measured, the particles moving away from the source penetrate the field in such a manner that numbers of the particles are decelerated and turned back to impinge upon the detector to produce a signal output proportional to the strength of the field being measured. An amplifying circuit and recorder are also provided. A reference magnetic field may be used in conjunction with the source and detector to produce a reference signal; and the magnetic properties of a test sample can then be measured by supporting the sample in the reference magnetic field to modify the reference field in accordance with the magnetic properties of the sample to produce a second signal output. The difference between the two output signals is proportional to a magnetic property of the sample being measured. (B.L.M.)

25371 FLUTTER-INSENSITIVE GEOMETRY FOR RADIATION GAUGING OF ROD-LIKE OBJECTS. Dukes, John R.; Allemang, Denman K. (to Industrial Nucleonics Corp.). U. S. Patent 3,240,940. Mar. 15, 1966. Filed Dec. 19, 1961.

A gaging head is provided for measuring the physical properties of an elongated, traveling workpiece in the form of a rod. The head includes means for loosely guiding the workpiece for longitudinal movement so that the central axis of the rod is substantially constrained to a nominal axis of travel. Only one line source of radiation whose cross-sectional dimension is substantially an order of magnitude smaller than the cross-sectional dimension of the workpiece is located on one side of the source adjacent to a plane whose locus is the nominal axis of travel. Only one radiation detector is located on the diametrically opposite side of the workpiece for providing an output indicative of the average intensity of radiation received by the detector. The line source is parallel to the plane and is so positioned that the detector output changes in the same direction when the workpiece axis is moved away from the nominal axis of travel in either direction perpendicular to the plane. This gaging head is designed to minimize or eliminate completely the effect of "flutter" or movement of the workpiece in any direction transverse to the axial travel normally so troublesome in instruments used for inspection of rod-type products. (B.L.M.)

25372 PROCEDURE AND APPARATUS FOR NUCLEAR DETECTION-ANALYSIS FOR USE ON ROAD SURFACES AND THE LIKE. Goldman, Howard J. U. S. Patent 3,243,793. Mar. 29, 1966. Filed Mar. 23, 1962.

A highly sensitive device is provided that utilizes beta particles to detect thin films or layers of beta absorbing or deflecting materials. The device is economical to construct, easy to maintain and useful for indicating the condition of a highway, landing strip, a helicopter propeller blade, an airplane wing, or other surface by sensing thin layers or film of rain, sleet, snow, frost, or ice. (B.L.M.)

Radiation Detection

Refer also to abstracts 25164, 25348, 25781, 25844, 25845, and 26358.

25373 (AD-631709) THE NONPROPORTIONAL RESPONSE OF A NaI(Tl) CRYSTAL TO DIFFRACTED X RAYS. Jones, T. H. (Naval Radiological Defense Lab., San Francisco, Calif.). Feb. 24, 1966. 37p. (USNRDL-TR-985). CFSTI $2.00 cy, $0.50 mn.

Measurements were made of the scintillation efficiency of a NaI(Tl) crystal for diffracted x rays in the energy range from 24.7 to 46.5 kev in 1-kev increments. The maximum deviation from linearity occurred in the region from 33 to 35 kev. The nonproportional response of NaI(Tl) to electrons in the region from 0.051 to 45.426 kev was then derived using a model of the energetic electron array produced in the crystal by the incident diffracted x rays. (auth)

25374 (AD-631742) STUDY OF SEMICONDUCTOR FAST-NEUTRON DOSIMETER FOR RANGE 0-50,000 RADS. Final Summary Report. Kramer, Gordon; Closser, W. H.; Mengali, O. J. (Battelle Memorial Inst., Columbus, Ohio). Apr. 1966. Contracts DA-18-108-405-CML-1031; DA-18-035-AMC-298(A). 102p. (NDL-TR-55). CFSTI $4.00 cy, $0.75 mn.

Results of a study of a semiconductor neutron dosimeter for the range 0 to 50,000 rads are presented. The dosimeter is a wide-base, conductivity-modulated, silicon p-n junction whose forward resistance increases upon exposure to neutrons, because of a decrease in excess carrier lifetime. The relationship between bulk properties of silicon, various processing steps, base width, and forward-current level on dosimeter performance were studied. The results of this study have led to development of an improved device for the required application. Advances in the dosimeter-fabrication process have led to increases in device uniformity. The need for adequate process control to prevent material contamination is emphasized. Lifetime degradation in the completed dosimeter and consequently higher response threshold has been attributed directly to the thermal-diffusion cycle, and a reduction in the temperature and time in this step is suggested to improve the sensitivity at lower neutron fluences. Present dosimeter response is accurate to ±25 percent at 50 rads (tissue) and improves rapidly at higher doses to ±2 percent at 50,000 rads (tissue). Long-term annealing effects at room temperature are shown to be negligible for dosimeter application. (auth)

25375 (AD-632284) EFFICIENT DETECTION OF LOW LEVELS OF RADIOACTIVITY IN SEAWATER. Redmond, A. H. (Naval Radiological Defense Lab., San Francisco, Calif.). Mar. 22, 1966. 22p. (USNRDL-TR-1000). CFSTI $1.00 cy, $0.50 mn.

The problem of assaying radioactivity in the sea was studied with a view to designing an optimum detector for gamma radiation spectra, with suitable statistical accuracy. The responses of a series of crystal detector spheres of

radii from 0.1 cm to 15 cm, having unit intrinsic efficiency to gamma rays were calculated for unit gamma emitter per unit volume. The principal result found was a large increase in counting rate as the solid angle of acceptance of the spheres for gamma radiation increased. With larger spheres the sample volume increased but gave a negligible increase in counting rate. Graphs are given for the series of spheres for energies between 0.137 and 3.6 Mev. A formula is given for the maximum counting rate for any size sphere under bombardment with any gamma energy. It can be used to estimate the size detector needed to count an emitter with required statistical accuracy, making allowance for intrinsic efficiency of the detector to gamma rays of a particular energy, and for any concentration of emitter. A procedure is outlined for selecting the particular isotope that has been activated by unit neutron fluence to obtain the maximum counting information in the shortest time. Differential counting of two isotopes over two different periods of time should give information on recency of activation. (auth)

25376 (AECD/EP–9) (n, CHARGED PARTICLES) EXPERIMENTS USING SEMICONDUCTOR DETECTOR. Haque, M. Aminul (Atomic Energy Centre, Dacca (Pakistan)). Jan. 1966. 13p. Dep. mn.

An introduction to the experimental approach to study neutron induced reactions using semiconductor detectors was presented. The emphasis was made mainly to explain the principle and characteristics of semiconductor detectors as used to detect the charged products in neutron induced reactions for the angular distribution studies. (auth)

25377 (AED-C–06-13) BIBLIOGRAPHIEN ZUR KERNFORSCHUNG UND KERNTECHNIK. SEKTION 06: MESSINSTRUMENTE UND MESSVERFAHREN IN DER KERNPHYSIK. (Bibliographies in Nuclear Science and Technology. Section 06: Instruments and Measuring Techniques in Nuclear Physics). Debertin, K. (comp.) (Zentralstelle fuer Atomkernenergie-Dokumentation, Gmelin-Institut fuer Anorganische Chemie und Grenzgebiete, Frankfurt am Main (West Germany)). Apr. 1966. 270p. Dep. mn.

Approximately 800 articles are included on all types of particle detectors and analyzers and associated electronic equipment use in nuclear physics experiments. (M.O.W.)

25378 (AFRRI-SR–66-3) EXPERIMENTAL DETERMINATION OF DOSE FOR THE MONKEY IN A REACTOR PULSE ENVIRONMENT. Dowling, J. H. (Armed Forces Radiobiology Research Inst., Bethesda, Md.). Feb. 1966. 42p.

Monkeys were exposed to a series of pulse exposures using a pulsing TRIGA reactor. The dosimetry measurements are described. The reported doses are based on the kerma calculated from threshold foil data for fast neutrons and the gamma exposure determined by silver activated glass rods. These values are compared with extrapolated (by monitoring sulfur) values determined using tissue equivalent ionization chambers for total dose, a Hurst proportional counter for fast neutron dose, and a graphite-CO_2 ionization chamber and a tetrachloroethylene chemical dosimeter for gamma dose. (C.H.)

25379 (ANL–6953) DETECTION SENSITIVITIES IN THERMAL-NEUTRON ACTIVATION. Wing, James; Wahlgren, Morris A. (Argonne National Lab., Ill.). Dec. 1965. Contract W-31-109-eng-38. 106p. Dep. mn. CFSTI $4.00 cy, $0.75 mn.

Detection sensitivities of the chemical elements in thermal-neutron activation are compiled from the available experimental cross sections and nuclear properties. The counts per minute per microgram of target element by techniques of 4π counting, single-gamma counting, gamma-gamma coincidence counting, beta-gamma coincidence counting, and triple-coincidence counting are tabulated for irradiation times of 0.5, 5, 50, 500, and 5000 min at a flux of 10^{14} thermal neutrons/sec-cm^2. For single-gamma counting, the source is 3 cm and 9.3 cm from the face of a 3-in. by 3-in. NaI(Tl) crystal. For coincidence counting, the source is 3 cm from two opposed 3-in. by 3-in. NaI(Tl) crystals. The results on the single-gamma countings are compared with the existing experimental data. Several applications of this compilation are discussed. (auth)

25380 (BNWL-SA–519) DEVELOPMENT AND EVALUATION OF A LARGE DETECTOR MULTIDIMENSIONAL GAMMA RAY SPECTROMETER. Wogman, N. A.; Robertson, D. E.; Perkins, R. W. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Apr. 1966. Contract AT (45-1)-1830. 3p. (CONF-660606–2). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From American Nuclear Society Meeting, Denver.

A multidimensional gamma spectrometer was fabricated using two 11-inch diameter by 6-inch thick NaI(Tl) crystals which are shielded from their phototubes with 4-inch thick pure NaI light pipes. Each NaI(Tl) crystal is surrounded by 36-inch diameter by 18-inch thick plastic phosphor which is viewed by six 5-inch phototubes and functions as an anti-coincidence shield. The spectrometer is coupled to a 4096 channel multiparameter analyzer and utilizes the gamma ray decay characteristics of each radionuclide for its identification and measurement. The performance of this system is described. (M.O.W.)

25381 (CERN–66-14) ISOTROPIC SPARK CHAMBER DEVELOPMENT IN THE AR DIVISION: SOME PRACTICAL RESULTS. Status Report. Gygi, E.; Schneider, F. (European Organization for Nuclear Research, Geneva (Switzerland)). Apr. 14, 1966. 11p. Dep. mn.

Two modes of operation of the isotopic spark chamber are discussed, the avalanche and streamer modes. The performance of the spark chamber, when operating in these modes, is discussed. (M.O.W.)

25382 (N–65-36441) DEVELOPMENT OF A PERSONNEL DOSIMETRY SYSTEM FOR APOLLO. Final Report. (Solid State Radiations, Inc., Los Angeles, Calif.). Sept. 1965. Contract NASw-415. 39p. (NASA-CR–65157). CFSTI $2.00 cy, $0.50 mn.

Investigation indicates that a dosimeter for the particle energy range and levels of interest of the Apollo mission can be fabricated within the envelope, weight, and power restrictions associated with a self-contained personal dosimetry instrument. Additional reduction in size and weight may be obtained through the conversion of the remaining subminiature printed circuit board components to thin-film hybrid circuitry. Design constraints and general systems design are discussed. A section on detailed system design considers the detector, amplifier, anticipated counting rates, pulse integration, readout circuit, d-c to d-c converter, and primary power source. Mechanical design data, test and calibration procedures, and schematic diagrams are included. (STAR)

25383 (N–66-15632) [FUNDAMENTAL STUDIES ON SEMICONDUCTOR RADIATION DETECTORS]. Semiannual Status Report, March 1–August 31, 1965. Casper, Karl J. (Western Reserve Univ., Cleveland, Ohio). 90p. (NASA-CR–69479). CFSTI $3.00 cy, $0.75 mn.

Techniques for the fabrication of lithium-drifted surface-barrier silicon detectors were investigated as was the use of indium antimonide is semiconductor detectors for gamma radiation. A magnetic beta spectrometer using semiconductor detectors in conjunction with a superconducting solenoid was developed and was used to observe the internal compton effect in ^{207}Bi. (D.C.W.)

25384 (N–66-16076) SCINTILLATION-TYPE NUCLEAR DENSITOMETER, MODEL 143A. HIGH COUNTING RATE, SCINTILLATION TYPE NUCLEAR DENSITOMETER, MODEL 143B. EVALUATION OF PRECISION GAMMA RADIATION DENSITOMETER TECHNIQUES FOR CRYOGENIC LIQUIDS. Final Report. (Franklin Systems, Inc., West Palm Beach, Fla.). Dec. 31, 1963. Contract NAS8-13. 179p. (NASA-CR–69709). CFSTI $5.00 cy, $1.00 mn.

Various nuclear radiation detectors were evaluated with the objective of developing a more accurate and reliable detector to replace the scintillation counters presently used for liquid oxygen and hydrogen densitometry. Studied were

the characteristics, design, and performance of ionization chambers, solid-state detectors, proportional counters, Geiger counters, as well as nuclear densitometers utilizing gamma radiation attenuation when passing through the liquid to obtain the mass absorption coefficient. A densitometer with a ^{137}Cs energy source seems to be feasible for liquid hydrogen measurements, and a densitometer with the more penetrating energy beam from a ^{60}Co source can be used to obtain attenuation measurements for liquid oxygen. (STAR)

25385 (NYO–3406-1) SENSITIVITY OF IMAGE INTENSIFIER-FILM SYSTEMS FOR OBSERVING WEAK LIGHT SOURCES. Technical Report No. 1. Reynolds, Geo. T.; Botos, P. (Princeton Univ., N. J. Elementary Particles Lab.). Feb. 15, 1965. Contract AT(30-1)-3406. 30p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

A representative systematic evaluation of an image intensifier-film system was described. The important parameters of tube gain, cathode efficiency, noise, film sensitivity, image quality, and signal to noise ratio were discussed. Although individual parameters and criteria will vary from problem to problem, the principles described afford a means for determining the factor of improvement that may be realistically assigned to the image intensifier system in certain particular applications for the observation of weak light sources. (auth)

25386 (ORNL-P–2105) PHYSICAL PROBLEMS OF DOSIMETRY OF NEUTRONS AND PROTONS. Auxier, J. A. (Oak Ridge National Lab., Tenn.). [1965]. Contract W-7405-eng-26. 21p. (CONF-660412–1). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From Symposium on Accidental Irradiation at Place of Work, Nice.

For convenience, the problems associated with the physical dosimetry of neutrons and protons are divided roughly into two groups—those for neutrons and protons of less than 20 Mev and those for neutrons and protons of 20 Mev and greater. For absorbed dose measurements, the assumption of equilibrium of incident and secondary particles cannot be applied to the higher energy region, and, in general, measurements of flux and at least a crude measurement of particle spectra must be made. Fortunately, there are several convenient detectors by which flux may be measured, e.g., the $^{12}C(n,2n)^{11}C$ reaction and the $^{12}C(p,np)^{11}C$ reaction. Similar reactions are useful for the energy region below 20 Mev, e.g., the widely used threshold detector systems, and in addition the energy region lends itself to absorbed energy measurements based on the Bragg-Gray principle, i.e., assuming that equilibrium of primary and secondary particles is possible. In general, protons of less than 20 Mev are not an important practical problem due to their low penetrating power. Neutrons from fission sources and low-energy accelerators are by far the most important sources of personnel exposures in the region below 20 Mev, and they are also the energies most commonly used in radiobiological research. For both energy regions, it is now considered most important to determine sufficiently the parameters associated with radiation field such that the most fundamental interaction phenomena may be computed. Particularly important are the linear energy transfer (LET) distribution and the macroscopic distribution of dose throughout the organism, including the various organs in the larger organisms such as man. The emphasis of research at the present time is upon physical measurements at a sufficiently definitive level that comparisons can be made with comprehensive calculations using digital computers, so that once a computation technique is proven it can be used to compute the various parameters in more detail than can be accomplished practically with experimental methods. (auth)

25387 (PPAD–583D) WIRE SPARK CHAMBER ELECTRONIC SYSTEM. Droege, T.; Fullin, W. (Princeton–Pennsylvania Accelerator, Princeton, N. J.). Feb. 10, 1966. Contract AT(30-1)-2137. 17p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

A set of wire spark chambers using magnetostrictive delay lines as the readout device was earlier successfully used in a high energy physics experiment. The electron system consists of a sequencer which performs the timing and control functions, one dual gate and two four digit scalers for each delay line, a clock, and assorted pulse fan-outs and power supplies. The electronic system used with this experiment is described. (M.O.W.)

25388 (UCRL–16539) SOME SOLUTIONS TO DATA-HANDLING PROBLEMS ASSOCIATED WITH THE MAGNETOSTRICTIVE SPARK CHAMBER. Kirsten, Frederick A.; Lee, Kai L.; Conragan, James (Lawrence Radiation Lab., Univ. of California, Berkeley). Mar. 2, 1966. Contract W-7405-eng-48. 19p. (CONF-660304–7). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From Institute of Electrical and Electronics Engineers, Scintillation and Semiconductor Counter Symposium, Washington, D. C.

The invention of the magnetostrictive spark chamber has created problems in detecting, digitizing, and storing the data from arrays of such chambers. These arrays are expected to vary widely in size from one experiment to another. The system of electronics developed for such use should be easily adapted to arrays of different sizes, and economically feasible for use with the largest arrays. Such a system is described. The basic components of the system are a preamplifier, timing discriminators, and digitizing and storage electronics. The preamplifier, designed to be mounted at the spark chamber, uses an integrated-circuit operational amplifier. It amplifies and clips the pulses from the transducer. The zero-crossing timing discriminator uses a tunnel diode in a cock-trigger circuit. The timing characteristics of the discriminator with expected variations in input pulse shape are described. The digitizing of spark location is accomplished with start/stop scalers operating with a 20-MHz clock. Scalers of 12-bit capacity can be used with chambers as large as 1 meter on a side. The digitizing and storage electronics was designed in modular form. The number of channels (transducers) and the number of sparks per gap can be expanded or contracted as required by a given experiment. The system can be used with any of three modes of connecting the transducers: parallel, series, or parallel-series. The use of integrated circuits has led to simplifications in the design and economies in production. (auth)

25389 (UCRL–16724) SENSITIVITY, RESOLUTION, AND LINEARITY OF THE SCINTILLATION CAMERA. Anger, Hal O. (Lawrence Radiation Lab., Univ. of California, Berkeley). Feb. 1966. Contract W-7405-eng-48. 31p. (CONF-660304–5). Dep. mn. CFSTI $2.00 cy, $0.50 mn.

From Institute of Electrical and Electronics Engineers, Scintillation and Semiconductor Counter Symposium, Washington, D. C.

In the scintillation camera described here, an array of 19 multiplier phototubes view a single, large, thin, sodium iodide crystal. From the relative amount of light seen by each phototube when a scintillation is produced, the position is determined in two dimensions and it is displayed as a point flash of light on an oscilloscope. Pictures are obtained by taking a time exposure of the oscilloscope screen. Pinhole or parallel multichannel collimation is used with γ-ray emitters, and coincidence techniques are used with positron emitters. (auth)

25390 PHOTOELECTRIC DOUBLE BEAM SPECTROMETER. Niewodniczanski, H.; Melzacki, K.; Pietruszka, J.; Pilawa, J. (Inst. of Nuclear Physics, Krakow). Acta Phys. Pol., 29: 553-61(Apr. 1966).

The design and construction of an optical spectrometer is described. Two entrance slits isolate the selected lines in the spectrum of a spectrograph. The emerging radiation is brought to the cathode of the photomultiplier tube by means of light-pipes with reflecting inside walls. The instrument records either a time-resolved spectrum ranging from 2,000 to 12,000 Å of a pulsed event or a total spectrum of a constant-intensity radiation source. (auth)

25391 IMPROVED DISCRIMINATION OF PARTICLE TRACKS IN DEVELOPED NUCLEAR PLATES. Benisz, J.; Panek, T. (Higher Pedagogical School, Katowice, Poland). Acta Phys. Pol., 29: 567-9(Apr. 1966).

A previously developed amplification method was used to discriminate between alpha-particle and proton tracks in nuclear emulsions. The nuclear emulsion plates K-2 and K-3 produced by Agfa and the plates Ja-2 produced in the USSR were irradiated, developed by the temperature method, whited for 30 min, and blacked for times from 0 to 50 min, and the thickness of the particle tracks was measured. Results of differences in the average thickness of the alpha and proton tracks for different blacking times are given for K-3 and Ja-2 plates. (M.J.T.)

25392 PION IONIZATION AT 321 Mev. Senent, F.; Sanchez, J.; Gil, G. (Facultad de Ciencias, Valencia). An. Real Soc. Espan. Fis. Quim. (Madrid), Ser. A, 62: 51-4(Jan.-Feb. 1966). (In Spanish).

An investigation of the tracks produced in a hydrogen-filled bubble chamber by 321-Mev mesons (π) is summarized. (D.C.W.)

25393 HIGH-RESOLUTION GAMMA SPECTROSCOPY WITH SEMICONDUCTOR DETECTORS. Gaeta, Rafael; Campos, Jose; Butragueno, Jose Luis (Junta de Energia Nuclear, Madrid). An. Real Soc. Espan. Fis. Quim. (Madrid), Ser. A, 62: 55-8(Jan.-Feb. 1966). (In Spanish).

The construction and performance of a new gamma spectrometer is studied. This spectrometer makes use of a n-i-p lithium-drifted silicon semiconductor counter. As an example of the spectrometer performance, the preliminary results of the ^{207}Bi, ^{133}Ba and ^{75}Se spectra are given. (auth)

25394 AN APPARATUS FOR THE ESCA METHOD. Fahlman, A.; Hagstroem, S.; Hamrin, K.; Nordberg, R.; Nordling, C.; Siegbahn, K. (Univ. of Uppsala). Ark. Fys., 31: 479-89(1966).

A high resolution electron spectroscopy for chemical analysis was constructed in which an electron spectrometer is adapted for the analysis of x-ray produced photoelectrons and Auger electrons. The apparatus is fully automatized and may be used for several applications in atomic, solid state and chemical physics. A determination of the iron K-level energy from a 930 ev photoelectron line, FeK ($CuK\alpha_1$), and the 10.362 ev photoelectron line FeK($MoK\alpha_1$) is reported. (auth)

25395 TRACK COUNTING METHOD FOR LOW ENERGY ELECTRON AND OPTICAL SPECTROSCOPY. Carlsson, R.; Fahlman, A.; Hallin, R.; Siegbahn, K. (Univ. of Uppsala). Ark. Fys., 32: 99-102(1966).

A method for detection of low energy electrons and quanta is described. The detection is made by a thin layer of Ilford K5 emulsion. The number of tracks formed in the emulsion per unit area is counted by means of a microscope with a magnification of 1250×. The track counting method is more sensitive than photometric methods and the exposure time can be appreciably reduced. In optical spectroscopy a considerably higher resolution is obtained in the region below 2000 Å than by conventional methods. (auth)

25396 ELECTROSTATIC PREACCELERATION OF ELECTRONS IN A LONG MAGNETIC SPECTROMETER. Lindskog, J.; Sparrman, P.; Marelius, A.; Sundstroem, T. (Univ. of Uppsala). Ark. Fys., 32: 417-28(1966).

Electrostatic preacceleration of electrons in a magnetic long lens spectrometer is treated. The design of a source holder which allows accelerating voltages up to 40 kv to be applied is described. The effect of the electrostatic field on the transmission of the spectrometer and on the transit time of the electrons through the spectrometer is treated in detail. An electrostatic lens which gives a spectrometer transmission of up to 30 per cent for low energy electrons with only minor changes in line width and line position is described. (auth)

25397 FULLY AUTOMATIZED ELECTRON COINCIDENCE SPECTROMETER. Sparrman, P.; Marelius, A.; Lindskog, J. (Univ. of Uppsala). Ark. Fys., 32: 429-35(1966).

An automatic control system for an electron-electron coincidence spectrometer is described and a brief review of the spectrometer and the slow-fast coincidence system is given. (auth)

25398 ANALYSIS OF DELAYED COINCIDENCE EXPERIMENTS. Sparrman, P.; Falk, F. Ark. Fys., 32: 447-61(1966).

Two new methods for data analysis of delayed coincidence experiments are described, together with a review of current methods in common use. Statistical errors are investigated analytically and by a Monte Carlo technique. The different methods are compared and experimental procedures giving the best statistical precision are suggested for various experimental situations. Some experimental difficulties and their influence on the choice of method are finally considered. (auth)

25399 MONITORING SYSTEM FOR β-ACTIVE GASES AND ITS ABSOLUTE CALIBRATION. Harms, J.; Weiss, H. (Oesterreichische Hochschule, Vienna). Atomkernenergie, 11: 251-6(May-June 1966). (In German).

At reactor sites exhaust air contains radioactive gases, such as ^{41}Ar. Monitoring of activity in the exhaust air makes special demands on the measuring system because the permissible concentration of activity in the exhaust air is relatively low and the indication of the activity must be an absolute one. A simple monitoring system for activity in the exhaust air is described. This monitoring system was constructed at the Atom-Institut der Österreichischen Hochschulen and is used for continuous control of the exhaust air of the reactor. At the maximal permissible concentration of ^{41}Ar the measured value amounts to three times the background value. The electronic part of the system was kept simple and reliable by using Geiger-Mueller counter tubes. Two methods of absolutely calibrating the measuring system were investigated. In order to compare the results of both, a calibration cell was constructed, which was also used for calibrating the actual measuring system. The results obtained with both methods within the measuring error of 10%. For further increases in the accuracy a method was developed that reduces the absolute measurement of gaseous activities to the absolute measurement of solid activities. By using this method the measuring error finally was decreased to 3.3%. The measured values were compared with the result of a mathematical estimation and with the measured values obtained with a coincidence-anticoincidence counter tube. (auth)

25400 THE USE OF METAPHOSPHATE GLASS IN INDIVIDUAL DOSIMETRY. Hardt, H.-J. (Bundesamt fuer zivilen Bevoelkerungsschutz, Bad Godesberg, Ger.). Atompraxis, 12: 135-40(Mar. 1966). (In German).

Measurements made on metaphosphate glasses by the German Federal Agency for Civil Defense during recent years, as well as the relevance of these measurements to individual dosimetry are discussed. In addition to the characteristics of Yokota glass, the requirements that a catastrophe dosimeter must meet are considered. (auth)

25401 THE ESSENTIAL SPECIFICATIONS OF THE HAMBURG 4π-LARGE VOLUME RADIOACTIVITY DETECTOR WITH LIQUID ORGANIC SCINTILLATOR. [PART] III. Heinrich, H. C.; Gabbe, E. E.; Whang, D. H. (Univ., Hamburg). Atompraxis, 12: 150-4(Mar. 1966). (In German).

The comparison of essential specifications of the Hamburg 4π large volume radioactivity detector with liquid organic scintillators with the corresponding values of NaI single- or multi-crystal detector systems demonstrated that the 4π detector is superior to crystal detectors by a factor of 100 to 500 with regard to sensitivity, E^2/B, and minimum counting time required for measuring the lower border line radioactivity in humans. Test radioactivities of only 0.01 to 0.5 μC are required instead of 1 to 100 μC in bio-medical research and nuclearmedical diagnosis if a 4π geometry whole-body radioactivity detector is used. These extremely low test radioactivities cause additional radiation burdens of only 0.1 to 2 mrem/year corresponding to 0.04 to 1% of the natural radiation burden

to the human body from endogenous and exogenous sources (≅260 mrem/year). (auth)

25402 NEW SEMIAUTOMATICAL APPARATUS FOR THE DETERMINATION OF BLOOD VOLUME AND THE COMPARISON OF MEASUREMENTS OF RADIOACTIVITY. Kuni, H.; Trost, A. (Philipps Univ., Marburg, Ger. Laboratorium Prof. Dr. Berthold, Wildbad i. Schwarzwald, Ger.). Atompraxis, 12: 251-4(Apr.-May 1966). (In German).

The construction and working procedure of a new semiautomatic apparatus for determining blood volume and measuring radioactivity are described. Without loss of exactness in measurements and comfort-in-action, it was possible to reduce the construction costs to approximately half the actual level. Possible uses were considerably enlarged by installing four complete measure-programs and numerous special equipment. (auth)

25403 MEASUREMENT OF CIRCULAR POLARIZATION OF GAMMA RAYS BY REFLECTION FROM A MAGNETIZED MONOCRYSTAL. Michalec, R. (Nuclear Research Inst., Czechoslavak Academy of Sciences, Rez). Czech. J. Phys., B16: 353-4(1966).

A method of measuring circularly polarized gamma rays scattering on a magnetized monocrystal is presented. This method permits an increase in the resolution of the experimental apparatus as well as the elimination of the background effect on the measurement. (J.F.P.)

25404 RADIOCARBON DATING OF ICE. Oeschger, H. (Univ., Bern); Alder, B.; Loosli, H.; Langway, C. C. Jr.; Renaud, Andre. Earth Planet. Sci. Lett., 1: 49-54(Mar. 1966).

A counter for ^{14}C-dating is described, which allows measurements of samples containing only 20 to 100 mg of carbon. It was used for dating of ice samples from the Tuto tunnel near Thule, Greenland. In addition to the generally used precipitation technique of the CO_2 from the melting ice by NaOH, trapping by molecular sieves was successfully applied. (auth)

25405 PROPOSED CALIBRATION FACTORS FOR VARIOUS DOSIMETERS AT DIFFERENT ENERGIES. Jones, A. R. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Health Phys., 12: 663-71(May 1966).

In order to permit a quicker and, in most cases, more accurate assessment of dose it is proposed that dosimeters, or dose-ratemeters, be calibrated and designed to follow the variations in dose absorbed in critical organs at various photon energies. The proposed calibration factors are based on measurements made on a realistic phantom. They apply to photons in the energy range 0.03 to 1.5 Mev. Five different kinds of dosimeter are considered: hand-held γ-survey meters, area γ-monitors, dosimeters carried on the person, γ-survey meters for use in disaster situations and environmental γ-monitors. (auth)

25406 SOLID-STATE PULSE SPECTROSCOPY OF AIRBORNE ALPHA RADIOACTIVITY SAMPLES. Lindeken, C. L.; Petrock, K. F. (Univ. of California, Livermore). Health Phys., 12: 683-91(May 1966). (UCRL-12336).

Direct alpha pulse spectroscopy of air samples collected on membrane filters eliminates the time delay for the decay of natural alpha background or requirements for special sample preparation. Air samples are collected on 1-in.-diameter Millipore SM filters at flow rates of 1 cfm for periods of 24 hr. Samples are counted at a pressure of 10 to 100 μ using a 450-mm^2 surface barrier detector. Detector output is fed through a low noise, charge-sensitive preamplifier, a biased main amplifier, and into a multichannel analyzer. Energy resolution of 200 kev (FWHM) or better is obtained. (auth)

25407 RESPONSE OF p-i-n JUNCTIONS TO LOW-ENERGY BETA-RAY EMITTERS. Baily, N. A.; Hilbert, J. W. (Hughes Research Labs., Malibu, Calif.). Health Phys., 12: 705-9(May 1966).

The use of solid state detectors for the monitoring of low energy beta rays was investigated. The solid state detectors utilized were Au-i-n structures using bulk silicon compensated by lithium drift techniques. Their count rate response was compared to the surface absorbed dose rate in polystyrene. This was accomplished through the use of a specially constructed extrapolation chamber. The ratio of the count rate to dose rate was studied as a function of source to detector distance, source size, and source thickness. It was found that under many conditions the correlation is sufficiently good that survey meters incorporating such detectors would give a satisfactory estimate of the skin dose for dose rates exceeding 100 mrad hr. (auth)

25408 LOW-BACKGROUND LIQUID BETA COUNTER. Gomm, P. J.; Eakins, J. D. (Atomic Energy Research Establishment, Harwell, Eng.). Health Phys., 12: 711-12(May 1966).

The construction and performance of a low-background liquid beta counter built primarily for the determination of ^{32}P in urine are described. Features of the counter include a liquid Geiger-Mueller tube, and an anti-coincidence shield consisting of 20 gamma counting tubes arranged in two concentric rings with the liquid counter in the center. Conventional electronics were used and pulses in anti-coincidence are recorded on a scaler. Efficiencies of seven liquid G-M tubes were determined with 10 ml of a calibrated solution of ^{32}P and found to vary between 6.0 and 7.6. To determine the average background counting rate for urine samples, specimens were taken from a number of people occupationally exposed to radioactive materials. The average counting rate from nine 10 ml samples was 4.7 ± 0.4 cpm, an increase of 1.6 cpm over the value obtained with distilled water. (H.G.D.)

25409 TRANSISTORIZED PARTICLE IDENTIFIER. Caini, V.; Forti, P. (C.A.M.E.N., Pisa, Italy). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci., NS-13: 10-17(Apr. 1966).

The particle identifier described is based on an approximation of Bethe's calculation, which is commonly used in nuclear reaction experiments. The outputs of two logarithmic amplifiers are added together and inverted, in an antilogarithmic circuit, to form the inherent product. The logarithmic amplifiers are operational amplifiers with two parallel, inverted, feedback silicon diodes. The logarithmic inverter, being symmetrical to the amplifiers, provides temperature compensation of the logarithmic elements. The circuit is designed to handle bipolar pulses of 1 μs width, like those obtained from common double line differentiated amplifiers. Curves showing actual identifier spectra are provided. (auth)

25410 COMPUTER CODE FOR REDUCTION OF COINCIDENCE COUNTING DATA. De Volpi, A.; Porges, K. G.; Jensen, G. (Argonne National Lab., Ill.). Int. J. Appl. Radiat. Isotop., 17: 277-85(May 1966).

A computer code COING is described, which may be used to reduce most types of coincidence counting data, including 4π β-γ and γ-γ. Input variables include particulars of identification, run time, clock times, total counts in single and coincidence channels, and normalizing sample volume. The fixed system parameters are dead times and coincidence gate times for each channel, background rates, decay constants, and associated standard errors. The code computes corrected single-channel and coincidence rates, specific disintegration rates at "zero" reference time, efficiencies, error limits, and a weighted mean when more than one case is run at one time. The program is used with either manual or automatic data transcription. This FORTRAN-II Code was adapted to the IBM-704, DDP-24, and CDC-3600. (auth)

25411 METHOD FOR CONTINUOUS MEASUREMENT OF TRITIATED WATER IN AIR. Gibson, J. A. B.; Burt, A. K. (Atomic Energy Research Establishment, Harwell, Eng.). J. Nucl. Energy, Pt. A/B, 20: 185-90(Mar. 1966). (AERE-R-4967).

An instrument was developed for the continuous measurement of tritium (HTO) in air in the vicinity of a heavy water reactor. Water is condensed continuously from the

air at the rate of 10 g/hr and the tritium activity is measured in a flow cell filled with anthracene crystals. The method was developed to improve the sensitivity of detection from 2.5 pc/cm^3 for an ion chamber system to enable the chronic level of 0.4 pc/cm^3 (0.08 mpc$_a$) to be continuously measured. The range of the instrument, using a logarithmic ratemeter is from the background sensitivity of 0.1 pc/cm^3–10^3 pc/cm^3 (250 mpc). The instrument can be operated in a high γ ray background and does not detect radioactive gases such as ^{41}Ar. Contamination of the cell is rapidly removed following a large release of tritium activity. (auth)

25412 WHOLE-BODY (HUMAN) COUNTER OF THE UNIVERSITY OF TOKYO. ITS STRUCTURE AND PERFORMANCE. Katsunuma, Haruo; Yoshizawa, Yasuo; Maeda, Kazuho; Takeuchi, Yoshiko; Imahori, Akira; Anzai, Ikuroh; Kusama, Tomoko; Kaneko, Masahito (Tokyo Univ.). J. Nucl. Sci. Technol. (Tokyo), 3: 114-17(Mar. 1966).

A description is given of the design and performance of a whole-body counter at the University of Tokyo. The apparatus is intended for use in medical research and as control measure for radiation protection. Three types of detectors are installed for whole body counting of the human subject: (a) 5-in. NaI(Tl) scintillation probe, (b) 2.5-in. NaI(Tl) scintillation probes, and (c) large plastic scintillation probes. Output signals from the detectors are analyzed in a 400-channel pulse height analyzer. The subject is measured either on: (a) stretcher, (b) chair, or (c) V-bottom bed. In using the plastic scintillation probes, counting for a period of 15 min suffices to detect 150 g of potassium in the body, allowing for a statistical counting error of 2.2%. Spectra from some human subjects are presented. (auth)

25413 NOTE ON EFFECTIVE CUT-OFF ENERGY OF NEUTRON FILTER. Yamamoto, Hisashi; Ohnishi, Tadahiro (Hitachi Ltd., Kanagawa, Japan). J. Nucl. Sci. Technol. (Tokyo), 3: 118-20(Mar. 1966).

It is shown that the relation between the effective cut-off energy and foil thickness, as illustrated by Tsuchihashi and Iizumi, can be obtained if the effective resonance integral and the value of the transmission function of the filter referred to the resonance energy of the foil are known. (L.B.S.)

25414 GAS AMPLIFICATION IN A PROPORTIONAL COUNTER WITH CARBON DIOXIDE. Zastawny, A. (Technical Univ., Danzig). J. Sci. Instrum., 43: 179-81 (Mar. 1966).

Measurements of gas amplification in a proportional counter with CO_2 were taken, at CO_2 pressures ranging from 0.75 to 2.00 atm. From these measurements a new formula was derived for gas amplification in a proportional counter. An attempt at a theoretical explanation of this formula is given. In contrast with other formulae for gas amplification, good agreement between the formula and experimental data was found in nearly the whole region of gas amplification in the counter. It is expected that the formula is valid for a variety of gases under pressures comparable to atmospheric pressure, and that it is particularly appropriate for polyatomic gases. (auth)

25415 HIGH-DOSE DETECTOR FOR GAMMA AND X RADIATION USING COMPTON SCATTERED ELECTRON. Hiraoka, Eiichi (Radiation Center of Osaka Prefecture). Jap. J. Appl. Phys., 5: 299-304(Apr. 1966).

A new method for measuring high doses of gamma- and x rays was tested by using ^{60}Co and a 15-Mev linac. The detector used was composed of a dielectric and lead absorber, utilizing the current caused by Compton electrons. The outputs were measured by a vibrating reed electrometer. The collected current densities are about 2.5×10^{-14} amp/roentgen/min/cm^2. It almost coincides with the value calculated from the process of Compton scattering. The detector was found to be almost energy independent in the energy range up to 13 Mev and it is expected that the energy independence up to higher energies can be realized. (auth)

25416 A PORTABLE DEVICE FOR MEASURING WEAK BETA CONTAMINATION BY SCINTILLATION TECHNIQUE. Payer, Karoly; Vasvari, Gabor. Meres Automat., 13: 367-9(Dec. 1965).

A portable, transistorized contamination meter for measuring weak beta and gamma radiation was constructed. The detector consists of a plastic scintillator in conjunction with a Zeiss M 10 FS 25 photomultiplier. The electronic portion contains a highly stabilized high-voltage power supply, a wideband amplifier, a pulse-shaping stage, and an integrating stage. The lowest detectable radioactive contamination is 3×10^{-4} μC/sq. cm. for weak β-radiation and 1.5×10^{-3} μC/sq. cm. for γ-radiation. (CFSTI)

25417 FUNDAMENTAL STUDIES ON SOLID CHEMICAL DOSIMETRY. OPTICAL STUDIES ON AZO DYE-CHLOROFORM SYSTEM. Kawanishi, Sueo (Hokkaido Univ., Sapporo). Nippon Igaku Hoshasen Gakkai Zasshi, 25: 1035-54(Dec. 1965). (In Japanese).

Fundamental studies were carried out on a dye-chloroform system and a dye-chloroform-liquid paraffin system irradiated with gamma rays. The radiation produces a color change due to the interaction between the dye and acid produced from chloroform by radiation. This color change with irradiation can be made the basis of a chemical dosimeter. It is probable that new molecular compounds are formed by the irradiation. On the basis of optical measurements at a wavelength of 540 mμ with methyl yellow as the dye, it is possible to calculate a G-value for the dye-chloroform system and a molar extinction coefficient of the molecular compound. Using methyl yellow as the dye, the optical density of the system after irradiation with gamma rays was directly proportional to the exposure dose up to 2000 R. The optical density for the same exposure dose increases with increasing methyl yellow concentrations. The addition of 4 to 5 times as much parahydroxyazobenzene as methyl yellow prevents color changes by irradiation with ultraviolet radiation and fading of the color produced with gamma rays. (TCO)

25418 CRITICALITY DETECTION AND ALARM SYSTEMS. Aspinall, K. J. Nucl. Eng., 11: 184-8(Mar. 1966).

A review of the criticality detection and alarm systems installed in the UKAEA establishments that are concerned with the processing of fissile material is summarized. (G.O.Y.)

25419 DETERMINATION OF CERTAIN PARAMETERS OF β-PARTICLE TRACKS IN $CaSO_4$–Mn. Nosenko, B. M.; Revzin, L. S.; Yaskolko, V. Ya. Opt. Spectros. (USSR) (Engl. Transl.), 19: 547-8(Dec. 1965).

Translated from Opt. Spektros., 19: 980-2(1965).

A method is proposed for evaluating the excitation density of β particle tracks in $CaSO_4$–Mn, which does not require a knowledge of the track volume and employs only luminescence experiments. (B.G.D.)

25420 SENSITIVE MONITOR FOR X-RAYS AND GAMMA RAYS. van Ammers, H.; Hesselink, J. (Philips Gloeilampenfabrieken, N. V., Eindhoven, Netherlands). Philips Tech. Rev., 26: 190-3(1965).

A radiation monitor is described which has an ionization chamber with a thin front face and thus responds to fairly soft radiation. The monitor is also highly sensitive. It can be used for measuring both exposures and exposure rates. For both cases there are three measuring ranges, viz: 1, 10, and 100 mR or mR/h. Under irradiation the voltage which the ionization current produces across the measuring resistor (or capacitor) is first amplified by an electrometer tube and then by four transistors. The amplifier is provided with a negative feedback circuit, which is also used for switching to a different measuring range. The power is supplied by two 1.5-volt dry cells and a converter in conjunction with a voltage stabilizer. A source (^{137}Cs; radioactivity <1 microcurie) is provided to check the instrument; the pointer can be accurately set to zero and checked at any time, even in a radiation field. The meter reading is only weakly dependent on the quality of the radiation and is ac-

curate to within 15% in a wide range of radiation qualities. (auth)

25421 GAS DENSITY STABILIZER FOR FLOW PROPORTIONAL COUNTERS. Deslattes, Richard D.; Simon, Bert G.; LaVilla, Robert E. (National Bureau of Standards, Washington, D. C.). Rev. Sci. Instrum., 37: 596-9(May 1966).

A controller for gas density (pycnostat) is described with particular view to gain stabilization in flow proportional counters. The device is capable of operation at small flow rates and at pressures both above and below atmospheric pressure. Construction details and performance measurements are reported. (auth)

25422 DESIGN OF PHOTOMULTIPLIER SOCKET ASSEMBLY WITH HIGH GAIN AND CLEAN OUTPUT SIGNALS FOR TUBES VIEWING ORGANIC SCINTILLATOR LIGHT PULSES. Gibson, William A. (Oak Ridge National Lab., Tenn.). Rev. Sci. Instrum., 37: 631-5 (May 1966). (ORNL-P-1915).

Two of the major problems in designing a socket assembly for a 56AVP photomultiplier viewing light pulses from an organic scintillator were investigated. They are optimization of the dynode voltage distributions for gain and pulse shape over a wide range of tube gains, and proper grounding of the dynode bypass capacitors and coupling of the coaxial signal leads to the anode and dynodes so that clean signals appear at the output. The effects of varying the dynode voltage distributions were studied; the results of improper distributions are discussed. A dynode voltage distribution is given which gave near optimum gain and pulse shape for several different 56AVP's viewing the light pulses from an organic scintillator illuminated by ^{239}Pu alpha particles over a wide range of supply voltages and with anode currents up to 1 amp. An electrical and mechanical layout is presented which results in electrically clean pulses from the 14th dynode and anode as well as clean integrated pulses from the lower dynodes; in addition, high gain is realized with adjustment of only the last dynode-to-anode voltage. Photographs of the output signals are shown for a wide range of tube gains, and curves of the relative gain and risetime as a function of tube voltage are given. (auth)

25423 OPTIMIZING CHANNEL UTILIZATION IN NaI SCINTILLATION SPECTROMETERS. Baum, J. W. (Brookhaven National Lab., Upton, N. Y.). Rev. Sci. Instrum., 37: 666-7(May 1966). (BNL-9796).

A system that was an equal number of channels per peak over the entire energy band was sought. It was found that the use of a nonlinear amplifier to modify the response of a linear gamma spectrometer makes it possible to use most of the analyzer channels in approximately the optimum manner. (D.C.W.)

25424 ORIGIN OF SPURIOUS PULSES IN AIR PROPORTIONAL COUNTERS. Bernaola, O. A.; Moreno, E. Browne; Cisneros, J. I.; Ferrari, A. M. R. (Univ. Nacional de Cuyo, Argentina). Rev. Sci. Instrum., 37: 673 (May 1966).

An investigation of the origin of spurious pulses in air-filled proportional counters is summarized. The results invalidate the explanation of the generation of spurious pulses in terms of corona discharge. (D.C.W.)

25425 THE NATIONAL BUREAU OF STANDARDS MOESSBAUER SPECTROMETER. Spijkerman, J. J.; Ruegg, F. C.; DeVoe, J. R. (National Bureau of Standards, Washington, D. C.). pp 53-8 of STI-DOC-10/50.

A drift-free Doppler spectrometer with a wide velocity range and high resolution is described. The spectrometer can be operated either in a constant-acceleration mode or in a constant-velocity mode. (D.C.W.)

25426 A STUDY OF THE TIME CHARACTERISTICS OF SCINTILLATORS IN CONNECTION WITH THE RESOLUTION OF TIME MEASUREMENTS IN NUCLEAR PHYSICS. Vilcov, N. Stud. Cercet. Fiz., 16: 941-1002 (1964).

A study was made on the time characteristics of scintillators and on the measuring methods used in determination of these characteristics: the method of phase differences; the oscilloscopic method; the method of time-constant variation; the method of delayed coincidences; the energetic method; and the method of formation lines. A method for measurement of the time-characteristics of oscillators is given. It allows for measurement of these scintillation-intervals, without neglecting the time-interval of the multiplier-front. By this method an accurate evaluation of the scintillation interval, inferred from the time-variations of the collector current, was made possible. The dispersion of electron flight-time through the photomultiplier was taken into account. Results obtained by this method differed from those derived by other methods only for the more rapid crystals, which is normal, if due regard is given to the effect of the interval-front of the photomultiplier used. (Rum. Sci. Bull.)

25427 ELECTRONIC CIRCUIT FOR DETERMINING THE BARYCENTER OF THE BREMSSTRAHLUNG PULSE. Baciu, G.; Catana, D.; Deberth, C.; Raileanu, I. (Inst. of Atomic Physics, Bucharest). Stud. Cercet. Fiz., 18: 133-9(1966). (In Rumanian).

In the study of nuclear phenomena, a time relation must be often established between the radiation pulse and the events generated by it. This problem was examined by analyzing the time-dependence relation between the pulse and the number of neutrons produced during a unit time and the possibility of measuring this dependence in the case of bremsstrahlung falling on a specimen for a given period Γ and a time dependent amplitude I(t), emitting neutrons by a (γ,n) reaction. Within short periods of Γ, up to several μseconds, the photoneutrons are emitted instantaneously. Neutrons passing through a paraffin moderator require longer periods than Γ to reach the surface of the moderator where they are sensed by a BF_3 detector after thermalization. The number of neutrons per second reaching the counter at a time t' after stoppage of the photoneutrons must be determined. The differential equation of this phenomenon includes members which characterize both the production and the thermalization of photoneutrons. The calculations showed that the barycenter of the radiation pulse does not coincide with the mean value because the pulse is not symmetric; therefore, an electronic circuit was used to find the barycenter of each successive pulse. The circuit which included a Cherenkov counter, is described. (TTT)

25428 CONTRIBUTIONS TO THE STUDY OF PHYSICO-CHEMICAL AND INSTRUMENTATION EFFECTS IN THE PRETREATMENT AND EXAMINATION OF NUCLEAR EMULSIONS. Anghelescu, Dan V. Stud. Cercet. Fiz., 18: 141-200(1966). (In Rumanian).

Since the discovery of radioactivity itself by means of a photographic plate, nuclear emulsions were used extensively for nuclear physics studies. After a historical review of the photographic method, the effect of treatment of nuclear emulsions are discussed, reviewing instrumental effects that may influence the processes that take place in the emulsion. The problem was experimentally studied by immersing Nikfi-K type nuclear plates in various liquids. The parasitary effects due to the use of binocular microscopes for the examination of the plates were also investigated. It was found that the path of α particles is increased by the immersion. The effect depends on the retention coefficient of the liquid and was found to be highest with ethyl acetate and lowest for ethyl ether, resulting in a lengthening by 21.3 and 3.2% of the path of the α particles with respect to the reference plate. Keeping the emulsion immersed until development favors the diffusion of the thoron atoms, resulting in an increase of the three-branched star tracks of Th−ThA−ThC'. In plates immersed in volatile liquid and then dried in the air, specific tracks with horizontal projections were found to appear; this is due to the porosity of the emulsion caused by the volatilization. Curvature of the visual field should be given more attention in work with nuclear emulsions. (Dissertation). (TTT)

25429 COINCIDENCE CIRCUIT IN THE NANOSECOND RANGE. Hulubei, V.; Savu, V. (Inst. of Atomic Physics,

Bucharest). Stud. Cercet. Fiz., 18: 229-31(1966). (In Rumanian).

A high-resolution circuit that may be used for the detection of particles with a broad energy spectrum because it does not require amplitude equalization, is described. Individual input pulses are distinguished through their action at a second input location where there is no signal at that time. The coincidence pulses not subject to such differentiation are extended and amplified. As the semiconductor diodes used in the circuit are not polarized, the resolution is obtained in a very short time period with high efficiency. The sensitivity was increased by using semiconducting diodes with characteristics starting at low voltages. The direct input resistance was decreased by connecting several diodes in parallel, resulting in an improved performance of the circuit. A study of the variation of the resolution time as a function of the cable length revealed that when the short-circuiting cable length is between 80 and 100 cm, the resolution time is approximately 2.5 nanoseconds. The whole system, especially the input points, must be well shielded. The circuit was operated for three months with excellent time stability. (TTT)

25430 EXOELECTRON DOSIMETER FOR X AND GAMMA RADIATION. Kramer, J. (Physikalisch-Technische Bundesanstalt, Brunswick). Z. Angew. Phys., 20: 411-17(Apr. 1966). (In German).

A dosimeter for x and γ rays which uses exo-electron emission is described. The instrument may be applied for personnel dosimetry. By using a suitable substance a linear function between the emission and the radiation intensity may be obtained about a large range. The dispersion of the results is small, no fading was found at room temperature. Under certain circumstances the instrument may be used at temperatures as high as 200°C. The dosimeter is independent of energy for some special substances and sample holders. Manufacturing of the device and measuring the exo-emission is easy. (auth)

25431 PARALLEL-PLATE FISSION CHAMBER, 30 PLATES /Q-2539/ (Engineering Materials). (Oak Ridge National Lab., Tenn.). (CAPE-1350).

2 drawings.

The chamber is used in determination of the ratio of the neutron-capture cross section to the neutron-fission cross-section at energies ranging 1 ev to 20 kev. The chamber housing is aluminum. Twenty-eight of the Al foil electrode plates are coated on both sides with ^{235}U. The end plates are coated on one side. The chamber is filled with 72 cm Ar and 3% CO_2 at a pressure of 72 cm Hg abs. (For details see TID-4100). (M.C.G.)

25432 AIR SAMPLER, MODEL 200 (Engineering Materials). (Los Alamos Scientific Lab., Univ. of California, N. Mex.). (CAPE-1355).

14 drawings.

The sampler described is a compact, completely portable instrument used in the qualitative detection of radioactive gases in the atmosphere. In the laboratory, it is used primarily for the detection of tritium in air in concentrations greater than 50 $\mu C/m^3$. It can be used as an in-place a-c or d-c operated unit. The detector is contained internally and consists of a 300-cc ion chamber. A blower circulates air through the chamber at 3 cfm. Rechargeable Ni-Cd batteries furnish power for the blower motor and alarm during d-c operation. The batteries recharge during a-c operation. (For details, see TID-4100). (M.C.G.)

25433 IMPROVEMENTS RELATING TO SOLID STATE RADIATION DETECTORS. Rouse, Robert Lindsay; Wakefield, James (to Associated Electrical Industries Ltd.). British Patent 1,025,111. Apr. 6, 1966. Filed Feb. 2, 1962.

A method for forming a p-i-n semiconductor junction device for the detection of gamma or x rays includes the step of depositing a layer of Li on the surface of a group III-V semiconductor compound, which includes one element having an atomic number greater than Ge; heating the semiconductor to cause the Li to diffuse into the semiconductor and form a p-n junction; and then applying a reverse electrical bias to the junction at a lower temperature in an inert atmosphere for a sufficient time to produce the required thickness of intrinsic layer. The preferred semiconductor is an Al-Sb or In-P compound. (B.L.M.)

25434 HOLDER FOR A FLUORESCENT GLASS ROD IN A RADIATION MEASURING APPARATUS. Yokota, Ryosuke; Nakajima, Saburo (to Tokyo Shibaura Electric Co.). German Patent 1,209,220. Jan. 20, 1966. Priority date Aug. 27, 1962, Japan.

A holder for glass rods is described in which the glass rods are mounted perpendicular to an ultraviolet source. This arrangement makes it possible to measure only fluorescence radiation emitted from the side wall of the rods. (Gmelin Inst.)

25435 DIFFUSION CLOUD CHAMBER WITH A ZONE OF SUPERSATURATED VAPOR. Boeke, Klaus (to Philips Patentverwaltungs GmbH). German Patent 1,210,092. Feb. 3, 1966. Filed July 29, 1964.

A peltier arrangement is used for cooling the lower portion of the chamber and controlling the height of the zone of supersaturated vapor. (Gmelin Inst.)

25436 PHOTOSENSITIVE LIGHT BEAM LOCATION INFORMATION DEVICE. Franck, J. V.; Broadhead, P. S. (to U. S. Atomic Energy Commission). U. S. Patent 3,222,526. Dec. 7, 1965.

Devices used for centering upon or automatic measuring of the relative location by measuring the coordinates of a point as represented by a light source or beam are described. Such a device provides for the measurement of the coordinates of a line or curve such as the path of tracks of ionizing radiations in a bubble chamber, cloud chamber or star image recorded on film. The patent describes a scanning system which generates independent scanning in what may be termed X and Y coordinate directions from a single beam thus providing a centering system with independent X and Y coordinate information. Another important use of the device is its ability to automatically home on a light beam representing the point to be located and recorded. The apparatus may be manually set to roughly center on a light image and electrically the machine will very rapidly and very accurately automatically center upon the light image and record the coordinates of that image. (AEC)

25437 FAST NEUTRON SPECTROSCOPE FOR MEASUREMENTS IN A HIGH INTENSITY TIME DEPENDENT NEUTRON ENVIRONMENT. Kronenberg, Stanley (to U. S. Army). U. S. Patent 3,238,369. Mar. 1, 1966. Filed Sept. 26, 1962.

A neutron spectroscope is patented that can determine the time dependent spectrum for neutron intensities ranging from 10^{26} to 10^{2} n/cm^{-2} sec^{-1} with a resolution of 10^{-9} sec. The apparatus may be made insensitive to gamma radiation by output compensation making it operative in mixed gamma and neutron environment. The apparatus includes a number of elements to be simultaneously exposed to the environment to be explored. Each element has a body of hydrogenous material with which the incident neutrons react to release protons having energies bearing a relationship to the energy of the incident neutrons. Absorbing means for each element in close proximity to the hydrogenous material have different absorption characteristics for the protons and act to absorb a portion of the protons reaching it and pass the remaining protons. Each element has a separate means for measuring the proton flux passing the absorbing means. The data can be interpreted mathematically in terms of the energy spectrum of the incident neutron environment. (B.L.M.)

25438 AUTOMATIC CORRECTION OF NUCLEAR INSTRUMENT TO COMPENSATE FOR NEUTRON ATTENUATION. Leeds, J. Venn Jr. (to U. S. Atomic Energy Commission). U. S. Patent 3,238,370. Mar. 1, 1966.

An apparatus for measuring neutron flux in a reactor and for automatically compensating for any neutron attenuation as a result of changes in water temperature and/or density is described. In a pressurized-water re-

actor the measurement of reactor power by a measurement of neutron flux may vary as a result of change in the temperature of the water. An operational amplifier having a Hall effect device in its feedback circuit is arranged to receive electric inputs related to the neutron flux and water temperature to give an electric output which is representative of actual reactor power. (AEC)

25439 SEAL. Martin, Kenneth B.; Pewitt, Edward G.; Fields, Thomas H.; Fetkovich, John G. (to U. S. Atomic Energy Commission). U. S. Patent 3,238,574. Mar. 8, 1966.

A seal that is leak-tight at high and low pressure differences and over wide ranges of temperature and is used between a metal mounting and an acrylic-resin lens associated with a bubble chamber is described. When the bubble chamber is cooled to a very low temperature, the contraction of the lens is appreciably greater than that of the mounting. Compensation for this unequal contraction is provided by two aluminum rings in the seal, one formed as a U having legs transverse to the axis of the ring, the other having a convolution in the shape of a U having legs parallel to the axis of the ring. (AEC)

25440 METHOD FOR DETERMINING THE NEUTRON FLUX ABOVE THE ^{238}U THRESHOLD ENERGY LEVEL. Roberts, E.; Wachter, J. W. (to U. S. Atomic Energy Commission). U. S. Patent 3,239,667. Mar. 8, 1966.

Neutron dosimetry and more particularly to a threshold detector for determining the neutron flux above the U-238 threshold is discussed. This is accomplished by providing two U-238 foils of low, but differing, U-235 content so that the activation due to thermal neutrons can be subtracted out by solving two activation equations simultaneously, thus permitting determination, by a further, simple calculation, of the activation of the U-238 alone. (AEC)

25441 ^{3}He THERMAL NEUTRON PROPORTIONAL COUNTER. Morgan, Ira L. (to Texas Nuclear Corp.). U. S. Patent 3,240,971. Mar. 15, 1966. Filed May 29, 1962.

A thermal neutron proportional counter comprises a circular cylindrical thermal-neutron-permeable enclosure having coaxial anode and cathode electrodes adapted for proportional ion multiplication, having a ratio of length to diameter of at least 4 to 1, and containing ^{3}He in a concentration of 0.0003 to 0.0014 mole/cm of length/inch of diameter. The helium must have a tritium content of less than 1 part in 10^{10}, and the helium pressure is from 2 to 7 atmospheres. (B.L.M.)

25442 MULTI-CHANNEL CHARGED PARTICLE SPECTROMETER WITH DELAY MEANS TO SEQUENTIALLY RECORD DETECTOR SIGNALS. Yamamoto, Hisashi (to Kabushiki Kaisha Hitachi Seisakusho). U. S. Patent 3,242,333. Mar. 22, 1966. Filed Dec. 24, 1962.

A multichannel charged particle spectrometer includes in combination a radiation source for emitting charged particles, a number of radiation detectors, means for creating an electromagnetic field to deflect the charged particles and selectively project each momentum of the particles into a different radiation detector, and a number of preamplifiers connected to the outputs of the detectors. The output of each preamplifier is divided into two parallel paths, the first path passing through a common first main amplifier and a first pulse height selector in series connection and the second path passing through series-connected delay circuits of the same number as preamplifiers. A second main amplifier and a second pulse height selector are connected in series. The second path of each preamplifier is connected to the input side of a different one of the delay circuits. The outputs of the first and second pulse height selectors are connected to a common time analyzer, and a multichannel recorder is connected to the time analyzer for converting the delayed output signals into signals to be counted and recorded in different channels of the recorder. (B.L.M.)

25443 SCINTILLATION DETECTOR SYSTEM USING A WHITE LIGHT AS A STANDARD TO STABILIZE THE SYSTEM. Scherbatskoy, Serge A. U. S. Patent 3,243,588. Mar. 29, 1966. Filed Aug. 17, 1962.

A standard white light source is provided for stabilizing an apparatus for the detection and measurement of nuclear radiation employing a phosphor adapted to produce scintillations in response to the radiation and a photomultiplier provided with a photocathode and a number of dynodes. The photomultiplier is optically coupled to the phosphor and produces a signal responsive to and representing the scintillations in the phosphor. The light source is arranged to illuminate with a standard illumination the same area of the photocathode that is optically coupled to the phosphor. The photomultiplier produces a second signal responsive to the standard light source illumination. Means are provided for separating the two electric signals from the photomultiplier, and the signal arising from the standard illumination is fed to the voltage supply of the photomultiplier to maintain the sensitivity of the tube substantially constant. (B.L.M.)

25444 RADIATION DOSIMETER. Forsman, Arnold H.; Gaskill, J. R.; Phillips, W. A.; Taylor, R. D. (to U. S. Atomic Energy Commission). U. S. Patent 3,243,590. Mar. 29, 1966.

A thermoluminescent personnel radiation dosimeter comprising granular, dosimetric lithium fluoride bonded to a section of graphite cloth by means of a radiation and light transparent inorganic binder is described. Thermoluminescent emission of light from the lithium fluoride is induced by resistively heating the graphite cloth. The dosimeter is rugged, durable, and re-usable, and is especially suited for automated readout processing. (AEC)

Radiation Effects

25445 (AD–631266) RADIATION EFFECTS ON INSULATED GATE FIELD EFFECT (MOS) INTEGRATED CIRCUITS. Second Quarterly Report, October 1–December 31, 1965. Report No. 2. Long, D. M. (Martin Co., Baltimore, Md.); Wrigley, C. Y. (Sprague Electric Co., North Adams, Mass.). Apr. 1966. Contract DA-28-043-AMC-01520(E). 34p. (ECOM–01520-2). CFSTI $2.00 cy, $0.50 mn.

A study was made to determine the transient and permanent effects of nuclear radiation on MOS transistors and integrated circuits. The activities of this quarter were concentrated in three major areas; test preparation, additional theoretical analysis, and device fabrication. Emphasis was placed on the latter of these three items. The test preparation efforts included: the procurement of parts; selection of measurement parameters and measurement techniques; development of detailed test plans; the design, construction and checkout of instrumentation circuitry; and the initiation of pre-irradiation measurements and flash x-ray testing. A shielded exposure box was constructed to reduce charge scattering and leakage currents in the flash x-ray instrumentation circuitry. The box reduced the response of the instrumentation circuitry by about an order of magnitude to levels less than 10 microamps. The theoretical analysis performed this quarter involved the investigation of damage mechanisms for the threshold voltage of MOS devices. Order of magnitude estimates and qualitative arguments are used to consider the effects of ionization, atomic displacements, and charge scattering. As a result of the analysis, the primary damage mechanism is tentatively identified as the sweeping out of ionization induced electrons from the oxide by electric fields in the oxide. However, much more theoretical and experimental work is needed to develop and confirm detailed models for MOS damage mechanisms. A detailed description is provided for the fabrication techniques, geometry, and materials used by Sprague Electric Company to manufacture the custom-built devices for this program. The construction of p-enhancement and n-depletion devices is discussed, as are the techniques for accomplishing controlled variations of manufacturing parameters on selected devices. (auth)

25446 (AD-631705) RADIATION EFFECTS ON (MONOLITHIC) MICROELECTRONIC CIRCUITS. Third Quarterly Report, November 1965-January 31, 1966. Report No. 3. Perkins, C. W.; Marshall, R. W.; Mitchell, E. P.; Liebschutz, A. M. (Hughes Aircraft Co., Fullerton, Calif.). May 1966. Contract DA-28-043-AMC-01313(E). 52p. (FR-66-17-57; ECOM-01313-3). CFSTI $3.00 cy, $0.50 mn.

This program is intended to provide an understanding of the effects of nuclear weapon radiation environments on military electronic systems using microelectronic circuitry of the monolithic silicon integrated type and, thus, to furnish engineering guidelines by which these systems may be hardened to these effects. The program is divided into three phases; (1) circuit evaluation, (2) diagnostic studies, (3) remedial action. Phase 1 was completed during this quarter with the circuit evaluation for permanent damage as determined in the pulsed reactor tests. The results of these tests how that the RCTL circuits are more susceptible to neutron damage than the RTL and DTL circuits. Radiation failure threshold depends on the initial gain of the transistors in the circuit. It is shown that this threshold can be raised by using high gain transistors or by using series combinations of transistors such as is used in the Darlington circuit. This threshold also decreases with fan-out and the criterion for circuit failure must, therefore, include the conditions of maximum fan-out encountered by the circuit. Diagnostic studies of the transient radiation effects in monolithic integrated circuits show that the principal mechanism is the generation of primary photocurrents in the substrate isolation diodes. The response of OFF gates can be entirely accounted for by the photocurrent generated in the collector-substrate junction of the output transistor. The magnitudes of these currents were determined in special tests on the components alone and on the circuits themselves. The technique by which the response of the circuit can be predicted from a measurement of these photocurrents is described, and the predicted radiation thresholds for failure are in fair agreement with the experimentally measured thresholds. (M.O.W.)

25447 (N-66-15448) THEORETICAL AND EXPERIMENTAL STUDIES OF RADIATION-INDUCED DAMAGE TO SEMICONDUCTOR SURFACES AND THE EFFECTS OF THIS DAMAGE ON SEMICONDUCTOR DEVICE PERFORMANCE. Semiannual Progress Report No. 3, March 1-August 31, 1965. (North Carolina State Univ., Raleigh. Semiconductor Device Lab.). 37p. (NASA-CR-69380). CFSTI $2.00 cy, $0.50 mn.

Various aspects of surface recombination and Metal Oxide Semiconductor (MOS) capacitors are reviewed in a comprehensive report of theoretical and experimental studies dealing with radiation damage and its effect on semiconductor device performance. Surface recombination velocity as a function of surface potential was studied for an oxide-silicon surface and its variation with gamma radiation. A new model for surface recombination velocity was developed. Variations in surface recombination velocity for p- and n-type silicon are considered as a function of gamma dosage; and bulk lifetimes are given for samples of both kinds before and after oxidation. (STAR)

25448 BEHAVIOUR OF ELECTRONIC COMPONENTS TO NUCLEAR RADIATIONS. Subramanian, T. V. A.; Upadhyayula, L. C.; Ramamurthy, S. G.; Somayaji, K. N. (Atomic Energy Establishment, Trombay, India). pp 97-100 of Proceedings of the Nuclear and Radiation Chemistry Symposium, 1964. Trombay, India, Atomic Energy Establishment, 1965.

The behavior of electronic components in combined gamma and neutron fields at elevated temperature was studied to find the suitability of the components for nuclear electronic instrumentation. The results obtained on film carbon and composition carbon-type resistors when irradiated in the "Apsara" reactor are described. The electrical parameters were measured for integrated dose rates. The general trend in the variation of parameters with integrated flux is shown. From the results obtained it appeared that there is a recovery after the irradiation is over and a threshold integrated flux, above which there are drastic changes in the parameters. (auth)

ISOTOPE TECHNOLOGY

General

Refer also to abstract 25384.

25449 ON THE TRIAL PRODUCTION OF UNIFORM INTENSITY SOURCE OF ^{60}Co γ-RAY. I. Okawa, Susumu; Tada, Motohiko (Imate Univ., Japan). Rep. Technol. Imate Univ., 18: 35-40(Oct. 1965). (In Japanese).

In an attempt to produce a uniform-intensity source of γ rays, ^{60}Co was electroplated on a copper plate. The plate was used with x-ray film to measure the thickness of limestone pieces and powder within the limits of 1 to 10 cm. (TCO)

25450 RADIOACTIVE RADIATION SOURCE WITH AN ESSENTIALLY SPHERICAL SHIELDING CONTAINER OF HEAVY METAL. Vogel, Rudolf (to VEB Transformatoren- und Roentgenwerk Dresden). German Patent 1,211,728. Mar. 3, 1966. Filed June 24, 1959.

The unit comprises a shielding container composed of a stack of circular plates made of heavy metal, the central plate of which consists of a fixed and a movable portion. The fixed portion of the central plate is provided with a radial channel into which the radiation source is introduced, and with a further radial opening through which the radiation may be emitted and which may be closed by the movable portion. (Gmelin Inst.)

Industrial Applications

Refer also to abstract 25355.

25451 STERILIZATION OF CATGUT BY IONIZING RADIATION. Meszaros, Gy.; Molnar, I.; Nagy, L.; Szita, J. Acta Chir. Acad. Sci. Hung., 6: 245-58(1965). (In German).

The history of sterilization by means of ionizing radiation is briefly reviewed. Comparisons were made regarding tensile strength, absorption, swelling, shrinking, and sterility of catgut sterilized by the classical method, by β particles accelerated in a Van de Graaff generator, and by γ rays emitted by ^{60}Co. Sterilization by γ rays was found to be superior to other methods, reliable sterility being obtained with a dose of 3.5 Mrep. Sterilization tests were conducted with highly radioresistant spores of Clostridium histolyticum that could be killed in vitro by a dose of 2.1 Mrad. However, some catgut samples irradiated at 2.5 Mrad were not sterile. The shrinkage temperature of ^{60}Co γ-irradiated catgut was 64°C after 2 Mrad, 63°C after 4 Mrad, and 56°C after 5 Mrad in comparison with 68°C in untreated catgut and 77°C in chemically sterilized gut (72% alcohol containing iodine). (BBB)

25452 RESEARCH ACTIVITIES OF THE ASSOCIATION EURATOM-ITAL. de Zeeuw, D. (Instituut voor Toepassing van Atoomenergie in de Landbouw, Wageningen, Netherlands). Atompraxis, 12: 231-6(Apr.-May 1966).

Research activities of the Association Euratom-ITAL (Instituut for Toepassing van Atoomenergie in de Landbouw Wageningen) are directed towards the practical application of radiation and radioactive elements and compounds in the field of agriculture, particularly in the spheres of food technology, growth and development of plant and animal, pest and disease control, and breeding. Results achieved thus far and new perspectives for the use of nuclear techniques in the field of agriculture are outlined. (P.C.H.)

25453 TECHNIQUES OF THE FUTURE FOR THE PRESERVATION OF FOOD PRODUCTS IN DEPOSITS. Mariani, Aldo. Atti Corso Qualificazione Tec. Ent. Merceologica, 1963: 85-93(1964). (In Italian).

Radiopreservation of food is reviewed with emphasis on required doses, units of measurement, radiation intensity, and the interaction of radiation with matter. Direct and indirect effects of radiation on biological and chemical systems are discussed. Radiosensitivity of the various stages in the life cycle of common pests are reviewed. Grain product irradiation is considered economically with particular reference to the situation in Italy. (TCO)

25454 DEFECTOSCOPY OF THIN HEAVY METALS BY MEANS OF FAST NEUTRONS. Gorbunov, V. I.; Pekarskii, G. Sh. (Kirov Polytechnic Inst., Tomsk, USSR). Defektoskopiya, No. 1, 35-9(1966). (In Russian).

Results of experimental studies on the transformation of the flux and spectral distribution of fast neutrons are reported. The possibility of using fast neutrons in radiation defectoscopy, particularly for determination of thicknesses of manufactured objects of heavy metals is shown. (tr-auth)

25455 CONSTRUCTION AND FIRST OPERATING RESULTS OF IRMA 400/1, THE FIRST MOBILE IRRADIATOR USING ^{137}Cs. Pierlas, R.; Frignet, G. Energ. Nucl., 8: 104-13(Mar.-Apr. 1966). (In French).

The Irma mobile irradiator was built to familiarize users with high radiation sources and to develop the design techniques for this type of apparatus. Reasons for choosing ^{137}Cs as the radioisotope are discussed. The irradiator, radiation source, and control and safety devices are described and the device's operation outlined. The handling of the containers and the capabilities of the apparatus are considered. (auth)

25456 WHAT RADIATION CAN DO FOR THE PRODUCTION LINE. Boehm, George A. W. Fortune, 70: 140-3; 152; 154; 158(Dec. 1964).

Expanding use of ionizing radiation in industry is reviewed. In 1964 sales radiation source amounted to about $1,500,000, and the value of commercial products irradiated in the process of manufacture reached $100 million. Both isotopes and beam-generating machines are discussed with regard to their advantages and disadvantages. Of 150 kw of radiation power installed on production lines in the U. S. by the end of 1964, only six came from ^{60}Co. The state of manufacture of electron beam producing machines is discussed. Some present and future possibilities for radiation sterilization are considered. Drugs that respond well to radiation sterilization include insulin, penicillin, streptomycin, cortisone, and several other steroid hormones. Irradiated polyvitamin preparations show no loss of potency after being stored at room temperature for years. Radiation may also be useful for inactivating the virulent organisms in vaccines. Rabies vaccine, for example, was prepared by irradiation. The treatment of polyethylene film for use in the food-packaging field was commercially successful. (BBB)

25457 EFFECTS OF ^{60}Co-γ-RAYS ON FRIED BEAN CURD. XI. RELATIONS BETWEEN THE OFF ODORS AND THE 2-TBA METHOD. Urakami, Chieko; Takamatsu, Motoko (Osaka Univ.). J. Jap. Soc. Food Nut., 18: 270-3(Nov. 1965). (In Japanese).

The two 2-TBA methods, Jacobson and Kirkpatrick's with the use of purified n-propanol and Yu-Sinhuber's without the use of an organic solvent, were compared for effects of irradiation doses on the press juices of both control and irradiated samples, the former method did not show an absorbance near 530 mμ, but the latter showed maxima at both 430 and 530 mμ. The method of Jordan and Veatch for determination of carbonyl compounds was also applied to the press juice but no sharp maximum was observed. Relations between the off odor induced by irradiation as well as the detection of deterioration on storage and absorbances at 430 and 530 mμ, by Yu-Sinhuber's method, were also studied; but no definite relation between the absorbances and the off odor and deterioration could be found. The 2-TBA method and alcoholic alkaline titra-

tion method were also compared for the detection of deterioration during the storage of the control sample. The latter method appeared to be more reliable at the present time. (auth)

25458 EFFECTS OF ^{60}Co-γ-RAYS ON FRIED BEAN CURD. XII. ACCEPTABILITY AND STERILIZATION. Kitamura, Machiko; Miyagawa, Kuniko (Osaka Univ.). J. Jap. Soc. Food Nut., 18: 274-7(Dec. 1965). (In Japanese).

The samples sealed under vacuum in Irax film were irradiated at dose levels of 2, 3, 4 and 4.6×10^5R, and some of these samples were heat-treated immediately after irradiation for removal of the off odors detected previously. The 2-TBA tests indicated that a significant decrease in absorbance at 530 mμ was observed by the heat-treatment but no difference at 430 mμ. Although a slight difference between the irradiated and irradiated heat-treated samples was detected by a panel test, the latter method, however, prolonged their shelf-life with no sign of deterioration up to 184 days compared with 45 days (in the preceding report) by irradiation alone. Duplicate runs on bacterial counts during a period of 30 days showed that the count of the sample irradiated at 4×10^5R remained around 10^2 all through the testing period. A relation between dose rates and shelf-life was also discussed. (auth)

25459 STORAGE LIFE OF VACUUM-PACKED ICED TROUT. II. INFLUENCE OF RADIATION PASTEURISATION. Joergensen, B. V.; Hansen, Poul (Fiskeriministeriets Forsoegslaboratorium, Copenhagen). J. Sci. Food Agr., 17: 140-1(Mar. 1966).

Irradiation of vacuum-packed gutted trout to doses of 200, 100, and 50 krads at 0° produced no immediate effect upon the flavor of trout after cooking. The eating quality declined independently of dose in subsequent ice storage. The irradiated fish were still edible after 4 weeks' storage but their quality as a first class food was retained for only about 3 weeks. At the 200-krad dose a total viable aerobic count of 1 million per g was not reached within 4 weeks. At doses of 100 and 50 krads this count was reached after 26 and 23 days, respectively. Non-irradiated fish that spoiled in the third week of storage reached a count of 1 million per g after 15 days. (auth)

25460 AN EVALUATION OF ^{125}I FOR INDUSTRIAL RADIOGRAPHY. Green, Farno L.; Graham, Gene P. (General Motors Research Labs., Warren, Mich.). Mater. Eval., 24: 249-52(May 1966).

An ^{125}I source of approximately 1.6 C was evaluated to determine its suitability for radiography of thin sections of aluminum and stainless steel. The objectives were to learn the characteristics of ^{125}I radiations transmitted through aluminum and stainless steel, to determine typical exposure times using industrial films of various speeds, and to obtain a radiograph of a typical industrial object. It was found that the radiations from the ^{125}I source studied would be useful for radiography of up to 0.250 in. of aluminum and up to 0.025 in. of stainless steel. (auth)

25461 MANGANESE-FREE RADICALS IN ^{60}Co GAMMA-IRRADIATED STRAWBERRIES. Shah, J. (Univ. of California, Davis); Maxie, E. C.; Landgraf, W. C. Nature, 210: 210(Apr. 9, 1966).

The presence of long-lived organic free radicals in irradiated fruits was investigated in Shasta strawberries exposed to 200 Krad ^{60}Co gamma rays at 0°C. No organic free radicals were found, but Mn^{2+} were detected in the samples. On the basis of available evidence, it is logical to assume that wholesomeness of irradiated strawberries is not affected by the presence of Mn^{2+} free radicals. (H.G.D.)

Power Application

See also ENGINEERING — Space Propulsion

Refer also to abstract 25776.

25462 (AGN-8135) EVALUATION OF RADIOISOTOPE APPLICATIONS IN HYDROSPACE. Final Report. Buck, K. E.; Lehman, J. P.; Black, R. H.; Fritzler, G. L. (Aerojet-General Nucleonics, San Ramon, Calif.). Mar. 1965. Contract AT(04-3)-368. 162p. Dep. mn. CFSTI $5.00 cy, $1.00 mn.

Studies were made on potential application of radioisotopes in hydrospace (surface and underwater), the development of parametric data with which to analyze the applications, and estimation of the quantity of radioisotopes that would be used for these applications during the next 10 years. Emphasis was made on the use of heat from radioisotopes either directly or by conversion to mechanical energy. The study showed that there are many potential applications of radioisotopes in hydrospace. Some applications concern existing hydrospace operations, such as offshore oil well drilling or the operation of military submarines, while others pertain to programs that are presently being pursued but are not yet operational. (P.C.H.)

25463 (N-65-34908) PARAMETRIC ANALYSIS AND CONCEPTUAL DESIGN OF A RADIOISOTOPE-THERMIONIC SPACE POWER GENERATION SYSTEM. Blair, L. S.; Ward, J. J. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). 1965. 21p. (NASA-TM-X-52122). CFSTI $1.00 cy, $0.50 mn.

The effects on efficient system performance of such design variables as the type of radioisotope used, the diode operating temperatures, the fuel block geometry, and the positioning of diodes around the fuel block are considered. A schematic diagram of the power system, and pertinent equations used in the parametric analysis are included. Results showed that, at lower fuel block power densities, system efficiency maximizes at a fuel block length-to-diameter ratio of 1; at high volume power densities, system performance is rather insensitive to length-to-diameter ratio. Heat rejection problems are considered, and methods of cooling the system by direct radiation to space are discussed. The necessity for fins is illustrated, and the relative advantages of side-mounted and end-mounted configurations are shown. System weight calculations are also discussed; it was concluded that, as regards performance level, emitter temperatures of 1800°K or higher, and effective fuel-block volume-power densities of several watts/cc are required to achieve system specific weights as low as several hundred pounds/kw(e). (STAR)

Separation and Production

See also CHEMISTRY — Separation Processes and Procedures

25464 (AECD/CH-8) PRODUCTION OF HEAVY WATER AT THE NATURAL GAS FERTILIZER FACTORY, FENCHUGANJ. A Feasibility Study. Huq, A. K. M. Shamsul (Atomic Energy Centre, Dacca (Pakistan). Chemistry Div.). Feb. 1966. 22p. Dep. mn.

Heavy water production techniques that are feasible in East Pakistan using hydrogen or methane as a feed material from a fertilizer factory are described. The methods described include: hydrogen distillation; chemical exchange; and methane distillation. Theoretically the methane distillation process appears attractive. (P.C.H.)

25465 (AERE-R-5097, Paper 8) ISOTOPIC FRACTIONATION DURING EVAPORATION. Eschbach, H. L. (European Atomic Energy Community, Geel (Belgium). Central Nuclear Measurements Bureau). 5p.

Efforts to evaluate precisely the ^{10}B content of boron layers deposited by evaporation are discussed. Calculations were made based on the assumption that the evaporation process is equivalent to Rayleigh distillation. Evaporation of boron was carried out from cylinders of natural boron by a procedure supposedly comparable to the method of successive dilution. A series of measurements indicated a sig-

nificant enrichment of ^{10}B in the evaporated layer, but results were not considered conclusive. (A.G.W.)

25466 (DUN-SA-11) PRODUCTION OF ^{233}U WITH LOW ^{232}U CONTENT. Boswell, J. M.; McCrosky, R. D. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Plant); Stringer, J. T.; Woods, W. K. (Douglas United Nuclear, Inc., Richland, Wash.). May 3, 1966. Contract AT(45-1)-1857. 22p. (CONF-660524-1). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From 2nd International Thorium Fuel Cycle Symposium, Gatlinburg, Tenn.

A program that resulted in the production of some 400 kg of ^{233}U with a ^{232}U content of only 5 to 7 ppM, and with an average manufacturing cost lower than that for the more highly contaminated ^{233}U is described. The formation of ^{232}U is controlled by irradiating ^{232}Th in an environment where the flux of highly energetic fission neutrons is minimized. The feasibility of handling large tonnages of thoria powder in open hoods was demonstrated. (P.C.H.)

25467 (K-1653) ENGINEERING-SCALE STUDIES OF BORON ISOTOPE SEPARATION. Merriman, J. R.; Pashley, J. H.; Snow, N. W. (Oak Ridge Gaseous Diffusion Plant, Tenn.). Apr. 15, 1966. Contract W-7405-eng-26. 117p. Dep. mn. CFSTI $4.00 cy, $0.75 mn.

Several disadvantages of boron isotope separation by the dimethyl ether process, which has been used on a production scale in the United States intermittently since 1945, led to engineering-scale studies of a more attractive alternative process based on a gas-liquid chemical exchange between boron trifluoride and a liquid complex formed between boron trifluoride and anisole. An engineering-scale test unit for the anisole process was operated essentially at total reflux, with reflux supplied by complex formation and dissociation in auxiliaries located, respectively, at the boron-11 and boron-10 ends of the separation column. Additionally, an anisole still was employed for continuous solvent purification. The 6-inch diameter isotopic exchange column was packed to a height of 13.5 feet with $\frac{5}{8}$-inch Pall rings. During this program, pressures of 20, 26, and 35 psia, anisole flow rates of 1.17, 1.75, and 2.0 gpm, and temperatures from 63 to 105°F were selected for the nineteen isotope separation tests. Correlations were developed for experimentally determined exchange column stage heights, which were found to range from 22 to 43 inches, depending upon the combination of operating conditions used, and for exchange column pressure drops, which varied between about 0.3 and 1.3 inches of water per foot of packing. One flooding test was performed at 28 psia. and 96°F with the indicated flooding flow on an anisole basis being 2.7 gpm. Both complex formation and dissociation were carried out with very low boron losses. The total anisole degradation rates during the tests appeared to be equivalent to between 3 and 7% of the anisole inventory in the still and decomposer systems per day. The choice of materials of construction appeared satisfactory on the basis of recycle liquid analyses. Stainless steel 304L was the primary construction material; however, stainless steel 316 and nickel packing materials were employed for the exchange column and for the higher temperature still and decomposer sections, respectively. Successful anisole purification and drying methods, as well as general system operability, were demonstrated. (auth)

25468 (MLM-1293) ENRICHMENT OF ^{21}Ne TO 62 PERCENT IN A 48-FOOT THERMAL DIFFUSION COLUMN SYSTEM. Kaminski, Kenneth J.; Eck, Charles F. (Mound Lab., Miamisburg, Ohio). Aug. 2, 1965. Contract AT(33-1)-Gen-53. 13p. (CONF-650902-13). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From American Chemical Society, 150th National Meeting, Atlantic City.

Due to the low natural abundance of neon-21, 0.28%, a significant amount of neon-21 has not been separated previously. Neon containing 2.2% neon-21 (86 stp liters) was separated from a system used for enrichment of neon-20 and neon-22. Neon-21 was further enriched from this intermediate gas in three separate operations; the stripping of neon-20, the stripping of neon-22 from the resulting mixture, and the batch-wise processing of the resulting mixtures to obtain over 400 stp milliliters enriched to 59% by removing additional neon-20 and neon-22. A profile peak concentration of 62 percent neon-21 was reached. (auth)

25469 (K-Trans-17) REVIEW OF ISOTOPE SEPARATION RESEARCH IN JAPAN. Report of the Special Committee on Isotope Separation. Translated for Oak Ridge Gaseous Diffusion Plant, Tenn., from Nippon Genshiryoku Gakkaishi, 7: 429-37(1965). 24p. Dep. mn. JCL $2.60 fs, $0.92 mf.

Research on isotope separation in Japan is reported. Summaries are given for studies on: methods for isotope separation; heavy hydrogen separation with Pd membrane; concentration of ^{13}C by thermal diffusion of methane; separation of lithium isotopes by molecular distillation of lithium metal; theory of isotope separation; electrophoretic separations; effects of a-c on separation of nitrogen and uranium isotopes; separation and concentration of isotopes by electrophoresis of fused salts; isotopic exchange equilibrium constant for ammonia–ammonium ion system; relation between isotopic ratio and chemical form of antimony during neutron irradiation; and separation of K, Ar, N, B, U isotopes. (P.C.H.)

25470 PRODUCTION AND USE OF FISSION PRODUCTS. Lefevre, J. (CEA, Paris). Energ. Nucl., 8: 86-93(Mar.-Apr. 1966). (In French).

The reserves of fission products coming from the retreatment of nuclear reactor fuels is of interest in the separation of certain of these radioisotopes. Their use where high activity is necessary (such as industrial irradiation and isotope generators of electricity) is discussed. ^{137}Cs and ^{90}Sr recovery processes are described. Special conditions for their separation presently prescribed for in France are given. (auth)

25471 SEPARATION OF ISOTOPE MIXTURE IN A FREE MOLECULAR JET. Mikami, Hisashi; Takashima, Yoichi (Tokyo Inst. of Tech). J. Nucl. Sci. Technol. (Tokyo), 3: 120-2(Mar. 1966).

Calculations are presented for estimating the effect of finiteness of nozzle exit size on the separation coefficient for an isotope mixture in a free molecular jet. (L.B.S.)

25472 MASS SPECTROMETER FOR THE PRECISE ASSAY OF THE LITHIUM ISOTOPES. Svec, H. J.; Anderson, A. R. (Ames Lab., Ames, Iowa). J. Sci. Instrum., 43: 134-7(Mar. 1966). (IS-1199).

A mass spectrometer is described in which precise comparison of lithium bearing samples may be made with standards. A sliding holder moves any of three samples into position over the ion source collimating lenses. Ions are formed by subliming each sample on to a separate heated tungsten or rhenium filament. Cross contamination of samples has not been observed. The expected precision in a $^{6}Li/^{7}Li$ measurement is better than 1 part in 1000. (auth)

25473 COLLECTION OF ISOTOPES IN THE C.S.I.R. ELECTROMAGNETIC ISOTOPE SEPARATOR. Smith, Hendrik Johann. Pretoria, University of Pretoria, 1964. 32p.

The design considerations for an electrostatic ion retarding system for collection of isotopes in the C.S.I.R. electromagnetic isotope separator is given, as well as a description of the completed apparatus. Preliminary results indicate that it has satisfactory focussing properties and that neutral particles can be separated from the ions. (auth)

METALS, CERAMICS, AND OTHER MATERIALS

General

Refer also to abstract 26394.

25474 (BNL-954, pp 122-67) METALLURGY AND MATERIALS SCIENCE DIVISION. Gurinsky, D. H. (Brookhaven National Lab., Upton, N. Y.).

Results of studies concerning the corrosive effects of Hg and alkali metals on high-temperature alloys are presented. Research on liquid-metal alloys of Na are reported including results of solubility experiments, density measurements, resistivity and thermoelectric measurements, and electromigration and diffusion experiments. Research progress is reported on high-field superconductivity. Investigations of radiation effects on mechanical and microstructural properties of Fe and steels are summarized. Studies of high-temperature core materials such as Br- and Rb-graphite lamellar compounds are summarized along with thermodynamic and electric properties of carbides, nitrides, and phosphides of Th, and zirconium carbides. Monitoring of the Brookhaven Reactor and HFBR is reported. Metallographic studies of meteorites are discussed along with field-ion microscopic studies of neutron-irradiated tungsten. (J.R.D.)

25475 (BNL-980) HIGH-TEMPERATURE LIQUID-METAL TECHNOLOGY REVIEW. A Bimonthly Technical Progress Review. Volume 4, Number 1. (Brookhaven National Lab., Upton, N. Y.). Feb. 1966. Contract AT(30-2)-Gen-16. 44p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Thirty-two reviews of progress and topical reports relevant to liquid metals at high temperatures are presented. Data tabulations and diagrams from the various reports and subject and issuing organization indexes are included. (W.L.G.)

25476 (CEA-Bib-43) LES APPLICATIONS METALLURGIQUES DU BOMBARDEMENT ELECTRONIQUE. (Bibliography on Applications of Electron Beam Techniques in Metallurgy). Le Levier, Marie-Genevieve (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Apr. 1966. 54p. Dep. mn.

References (259) are given to journals and reports published from 1960 through 1965. Separate author and subject indexes are included. (P.C.H.)

25477 (NLCO-971) DESIGN AND OPERATION OF A VACUUM CATHODIC ETCHING UNIT. Wise, W. N. (National Lead Co. of Ohio, Cincinnati). May 1966. Contract AT(30-1)-1156. 16p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

The design, construction, and operation of a vacuum cathodic etching instrument are discussed. A special feature of the design is a liquid-cooled zirconium cathode with a horizontal surface for supporting the sample. Both mounted and unmounted uranium metal samples can be etched in 30-minute cycles using argon as the bombarding gas. (auth)

25478 (SGAE-CH-28/1966) DER CHEMISMUS DES "MOLECULAR PLATING"-VERFAHRENS. (The Chemistry of the "Molecular Plating" Process). Proksch, E.; Getoff, N.; Bildstein, H.; Saukel, H.; Eschweiler, H.; Szinovatz, W. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf). 1966. 17p. Dep. mn.

Several platings obtained by electrolysis of metal salt solutions highly diluted with certain alcohols or ketones (Molecular Plating process) were investigated by ir reflection spectroscopy. With the exception of the noble metals, the primary cathodic deposit consists of hydroxides or oxides, irrespective of the nature of the metal salt used. The anions may be found at the anode provided they are chemically bound there. The electrolytic deposition processes are accompanied by decomposition of the water contained in the solution and by an attack on the organic solvent (dimerization and oxidation), as was found by gas chromatographic analysis. (auth)

25479 (USBM-RC-1232) QUARTERLY METALLURGY PROGRESS REPORT NO. 30, JANUARY 1-MARCH 31, 1966. (Bureau of Mines, Albany, Oreg. Albany Metallurgy Research Center). Contract AT(11-1)-599. 19p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

The newly designed spin-casting arc-furnace for high melting-point carbides is now in operation. Trial runs show considerable versatility and freedom of adjustment of variables. The effects of thoria additions on the tensile properties of thorium in the temperature range 400 to 800°C were investigated. Additions of up to 5% thoria made no significant change in the tensile properties. Metallography, density, and alloy content data were obtained for each W-Re-Mo sleeve. Impurity analyses were recently made of several samples to characterize the sleeves made this fiscal year. Recovery of the rhenium from scrap was started. Extruded bars of W-25Re were fully conditioned to stock suitable for sheet rolling. Heavy metal losses were encountered, especially in the powder-processed alloy. (W.L.G.)

25480 OXIDATION OF BERYLLIUM DURING HEATING IN AIR. Mal'tsev, M. V.; Morozov, L. N.; Zverev, K. P.; Efremov, Yu. N. Izv. Vyssh. Ucheb. Zaved., Tsvetn. Met., No. 1, 116-18(1966). (In Russian).

During heating in air, hot compressed and extruded beryllium was stable up to 600°C. At higher temperatures, above 800°C, significant oxidation was observed, being accompanied simultaneously by the formation of porous oxide films on the surface of the metal. It was concluded that these processes need to be considered during hot- and cold-working of beryllium. (tr-auth)

25481 HIGH TEMPERATURE-HIGH PRESSURE CELL FOR MEASURING DENSITIES OF METALS BY RADIATION COUNTING TECHNIQUE. Dillon, I. G.; Nelson, P. A.; Swanson, B. S. (Argonne National Lab., Ill.). Rev. Sci. Instrum., 37: 614-19(May 1966).

Equipment and techniques were developed for measurement of densities of metals at high temperatures (up to 2200°K). The equipment and techniques were demonstrated using alkali metals, but are generally applicable not only to most metals but also to many other substances. The determination of vapor and liquid densities of alkali metals at high temperatures and pressures was accomplished by measuring the radiation emanating from the vapor and liquid phases of a radioactive alkali metal contained in a high-pressure cell fabricated from a molybdenum-30 wt % tungsten alloy. The procedure was used to obtain vapor and liquid phase densities of the alkali metals at temperatures up to 2200°K and pressures up to 500 atm, which approach critical conditions. The radiation counting method involves sealing the metal whose density is to be measured in a containment capsule, irradiating the capsule and metal to produce a gamma-emitting isotope of the metal, charging the capsule into the high-temperature cell, and counting the activity of the vapor phase and the liquid phase at temperatures ranging from room temperature up to the critical point. A calibration of density vs irradiation level is performed at low temperatures where accurate liquid density data are available. (auth)

25482 IMPROVEMENTS IN OR RELATING TO THE PRODUCTION OF FUEL ELEMENTS FOR NUCLEAR REACTORS. Rolling, Heinz Eberhard (to Zentralinstitut fuer Kernphysik). British Patent 1,024,765. Apr. 6, 1966. Filed Dec. 28, 1962.

A method is described for the production of a matrix material consisting of alloyed or non-alloyed Al powder to be used as the dispersing matrix for the fissile material in the fabrication of dispersion type reactor fuel elements.

The surface of the powder is provided with a chemically inert coating of Al_2N_3 by treating the powder with a gaseous or liquid nitrogen containing substance at a pressure of 1 to 100 mm of Hg and at a temperature of 500 to 650°C for 2 to 8 hours. (B.L.M.)

25483 SPIRAL FLUIDIZED BED DEVICE AND METHOD FOR COATING PARTICLES. Latta, R. E.; Funston, E. S. (to U. S. Atomic Energy Commission). U. S. Patent 3,251,337. May 17, 1966.

A spiral fluidized bed reactor for coating discrete particles such as refractory nuclear fuel particles is described. At least one tangential gas inlet for ingress of a fluidizing gas is provided in the wall of a hollow member which is axially disposed in an inverted frusto-conical chamber adapted to hold the particles, thereby providing an annulus for spiral flow of the fluidizing gas upward through the chamber for fluidization of the particles. Coating gas is passed down through the hollow member and out a gas port disposed within the wall of the member and mixed with the upward spiral flow of the fluidizing gas. (AEC)

Corrosion

Refer also to abstract 26465.

25484 (NASA-CR-54912) POTASSIUM CORROSION TEST LOOP DEVELOPMENT. Quarterly Progress Report No. 9, July 15, 1965–October 15, 1965. Hoffman, E. E. (ed.) (General Electric Co., Cincinnati, Ohio. Space Power and Propulsion Section). Feb. 21, 1966. Contract NAS 3-2547. 64p.

The Prototype Corrosion Loop reached the test design conditions on Aug. 2, 1965, at 1500 after 100 hr of boiling and condensing operation at potassium boiler outlet temperatures in the range 1300–1900°F. As of Oct. 15, 1965, 1785 hr of stable operation were completed. The system normally operates in an extremely stable manner with no detectable variations in potassium flow, pressure, or temperatures in the two-phase potassium circuit. The stability achieved in the potassium circuit is attributed mainly to the pressure drop across the metering valve at the preheater inlet and to the wire wound plug section located in the first 12 in. of the boiler. Activation of the vapor nucleator located between the preheater and the boiler was not required to achieve stable loop operation. Failure of a fuse in the potassium preheater power supply caused the nucleate boiling region to move out of the 12-in. plug section and up the boiler. The resulting instabilities in the system persisted for approximately one hr until restoration of preheater power to the system returned the nucleate boiling region to the plug section and stable operation was resumed. The pressure in the test chamber was 3.0×10^{-7} torr when the loop reached the test conditions, decreased to the 10^{-8} torr scale after 120 hr of operation and reached 2.7×10^{-8} torr after 1785 hr of test operation. Argon and nitrogen/carbon monoxide were the principal gaseous species of the chamber environment and after 1785 hr of test operation comprise approximately 83% of the total indicated pressure. Argon instabilities in the getter-ion pump continue to cause momentary increases in the test chamber pressure. The argon flooding safety system, which is activated by an increase in the chamber pressure, was modified to avoid inadvertent test shutdown as a result of these argon releases from the ion pump. Analysis of the performance of the loop indicates that the variations between the actual test conditions and the reference design test conditions are minor. No trends in either the performance of individual components or in overall operation that would indicate component degradation were detected during loop operation. (auth)

25485 (NASA-TN-D-3429) COMPATIBILITY OF COLUMBIUM AND TANTALUM TUBING ALLOYS WITH REFLUXING POTASSIUM. Scheuermann, Coulson M.; Barrett, Charles A. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). May 1966. 42p. CFSTI $2.00 cy, $0.50 mn.

The corrosion resistance of potential niobium and tantalum tubing alloys to refluxing potassium was tested at temperatures bracketing the maximum expected use temperatures of the advanced turboelectric space power systems, 1800 to 2400°F. Tests were conducted with reflux capsules made from rod stock machined to $\frac{1}{2}$-inch diameter, $1\frac{3}{4}$-inch length, and 0.040-inch wall thickness. The capsule wall served as the test specimen. The initial oxygen content of the potassium was a maximum of 20 ppM. The oxygen content of the materials was generally 100 to 200 ppM. The tests were performed in a vacuum of 10^{-7} to 10^{-8} torr for times up to 4000 hours. The materials studied were the niobium alloys B-33, SCb-291, Nb-1Zr, D-14, B-66, FS-85, AS-55, D-43, C-129, and Nb-752; and the tantalum alloys Ta-10W, T-111, and T-222. The gettered alloys (i.e., those containing the reactive elements zirconium or hafnium) were found to be more resistant to corrosive attack than the ungettered alloys under the test conditions. This behavior is attributed to the reaction of the gettering elements with dissolved oxygen in the alloy to form stable oxide precipitates within the alloy and thus prevent this amount of oxygen from entering into the corrosion reactions. A mechanism is proposed, based on experimental results, that describes the oxygen accelerated corrosive attack of Nb and Nb alloys by potassium under refluxing conditions, involving the formation and solution of complex oxides. This mechanism may be expected to be applicable, in principle, to the other refractory metal–alkali metal systems as well. Cases of gettered and ungettered alloys are considered. The various reaction products, their roles in the corrosion process, and their disposition are discussed. (auth)

25486 (NLCO-957) EFFECT OF ENVIRONMENTAL CONDITIONS ON THE PITTING OF URANIUM. Kato, T. R.; Price, D. H. (National Lead Co. of Ohio, Cincinnati). Dec. 1965. Contract AT(30-1)-1156. 7p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Corrosion pitting of uranium fuel cores during fabrication can be mitigated by controlling the environmental conditions under which they are produced. Moisture, chloride ion concentration, exposure time, and differential aeration were found to be especially important in the control of pitting. (auth)

25487 (ORNL-3947) OXIDATION OF UNFUELED AND FUELED GRAPHITE SPHERES BY STEAM. Rutherford, J. L.; Blakely, J. P.; Overholser, L. G. (Oak Ridge National Lab., Tenn.). May 1966. Contract W-7405-eng-26. 37p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

The oxidation of various unfueled and fueled graphite spheres (1.5-in. and 2.36-in. dia) by steam was studied at 800, 900, and 1,000°C using a partial pressure of ~730 torr and flow rates of 600 to 1,200 cm^3/min (STP) of steam. The fueled spheres contained pyrolytic-carbon coated UC_2 or $(U,Th)C_2$ particles dispersed in graphite matrices; the unfueled spheres were machined from ATJ and Speer Moderator-2 grades of graphite. Reaction rates were determined from weight changes and analyses of the effluent gases. Pronounced effects of burnoff on reaction rates and CO/CO_2 ratios were observed. BET surface area and mercury porosimetry data obtained for several oxidized unfueled spheres are included. Reaction rates measured for the fueled spheres were, in general, comparable to those found for the unfueled spheres. The graphite matrices appear to have afforded considerable protection for the coated fuel particles against attack by steam. (auth)

25488 (WAPD-TM-500) THE EFFECTS OF HEAT TREATMENT ON THE CORROSION AND HYDROGEN ABSORPTION CHARACTERISTICS OF A ZIRCONIUM–NIOBIUM–COPPER (Zr + 2.5 percent Nb + 0.5 percent Cu) ALLOY. Kass, S. (Bettis Atomic Power Lab., Pittsburgh, Pa.). Mar. 1966. Contract AT(11-1)-Gen-14. 27p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Corrosion tests in 600 and 680°F water and in high pressure steam at 750 and 950°F revealed that the Zr–2.5% Nb–0.5% Cu alloy possesses favorable corrosion characteristics. Optimum properties were obtained when

the alloy was quenched from the alpha-plus-beta region and subsequently aged in the alpha region. (auth)

25489 (WAPD-TM-533) THE CORROSION AND HYDROGEN PICKUP OF ELECTRON BEAM WELDED NICKEL-FREE ZIRCALOY-2 AND ZIRCALOY-4. Kass, S. (Bettis Atomic Power Lab., Pittsburgh, Pa.). Mar. 1966. Contract AT(11-1)-Gen-14. 22p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Corrosion tests with Zircaloy-4 and nickel-free Zircaloy-2 exhibiting large alpha grains formed by electron beam welding and annealing at 1450°F revealed that the large grain material does not corrode at rates significantly different from finer grained material, nor does the large grain material exhibit greater tendencies to absorb hydrogen than the finer grain materials. (auth)

25490 (WAPD-TM-544) THE EFFECT OF SILICON ON THE CORROSION AND HYDROGEN ABSORPTION CHARACTERISTICS OF ZIRCALOY-4 AND NICKEL-FREE ZIRCALOY-2. Kass, S. (Bettis Atomic Power Lab., Pittsburgh, Pa.). Apr. 1966. Contract AT(11-1)-Gen-14. 21p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

The corrosion and hydrogen absorption characteristics of Zircaloy-2, Zircaloy-4, and nickel-free Zircaloy-2 containing added quantities of silicon were determined. Silicon additions caused no significant alterations in the 680°F corrosion resistance, but produced marked reductions in the tendencies for the alloys to absorb hydrogen during corrosion exposure. The hydrogen absorption characteristics were found to be dependent upon silicon contact and prior thermal treatment. (auth)

25491 (AECL-2330, pp 179-95) THE CORROSIVE ACTION OF DIPHENYL ON METALS AND THEIR OXIDES. Bychkov, Yu. F.; Lantev, I. D.; Rosanov, A. N. Translated from pp 151-63 of Issledovaniya po Primeneniyu Organicheskikh Teplonositelei-Zamedlitelei v Energeticheskikh Reaktorakh, Atomizdat, Moscow, 1964.

The transformations which can occur with reactor materials exposed to biphenyl and the effect of such factors as the presence of admixtures and the degree of pyrolytic decomposition were investigated. The hydride mechanism of corrosion was investigated first with respect to uranium and its alloys with molybdenum. The corrosion tests with biphenyl were carried out in containers made of 1Kh18N9T stainless steel. After evacuating the containers with the specimens, they were pressurized in an arc furnace in an atmosphere of pure argon. The changes undergone by a variety of metals, alloys and oxides are tabulated. The effect of admixtures of water (0.0004-0.7 wt %) and sulfur (1-3 wt %) to biphenyl on its corrosive properties was also investigated. The results indicate that metals and oxides are subject to the following types of transformations in biphenyl: reduction of oxides and hydroxides to the metal or another oxide; formation of hydrides; formation of carbides; and oxidation. Admixture of water to biphenyl in amounts greater than 0.2% was shown to hasten the corrosive failure of aluminum AD-1 and SAP-1 alloy and lead to intercrystalline corrosion, as well as embrittling and lowering the strength of the metals. Corrosion was also accelerated by sulfur. Admixtures of water do not affect SAP-1 alloy as much as aluminum AD-1. (ATD)

25492 (AECL-2330, pp 196-217) COMPATIBILITY OF SEVERAL CONSTRUCTION MATERIALS WITH ORGANIC COOLANTS. Nevzorova, A. A.; Nikitin, K. N.; Bogodina, N. A. Translated from pp 164-81 of Issledovaniya po Primeneniyu Organicheskikh Teplonositelei-Zamedlitelei v Energeticheskikh Reaktorakh, Atomizdat, Moscow, 1964.

Corrosion tests were carried out for a number of structural materials (Mg and its alloys, Al and its alloys, Zr and its alloys, Ti, Nb, Ta, Fe, carbon steels 3, 20, 45, 0, 8G, low-alloy steels Kh5M and 48TS-2, and stainless steel 1Kh18N9T) in gas oil, monoisopropylbiphenyl, and hydrogenated terphenyl at 330 to 400°C. It was established that the initial phase of corrosion in organic heat-transfer agents is oxidation of the metals by admixtures of water and oxygen. The rate of the initial phase of corrosion and the properties of corrosion films on the surface of the metals are the same as those in moist air or superheated steam at the same temperatures. It was also found that, in addition to admixtures of water and oxygen, the products of the pyrolysis of hydrocarbons are also aggressive agents. The corrosion behavior of these metals enables one to classify them as follows: materials on the corrosion resistance of which pyrolysis products have little effect (Al and its alloys and stainless steel 1Kh18N9T); materials which absorb pyrolytic hydrogen (Zr and its alloys, Nb, and Ta); materials which corrode in hydrocarbons with a loss of weight (Mg and its alloys and Fe). The best materials for reactors with organic heat-transfer agents were found to be aluminum alloys, AZhN alloy (Ni, Fe, Si, and Al) and stainless steel, and addition of Mg to Al alloys was found to promote intercrystalline corrosion. (ATD)

25493 OXIDATION PRODUCTS OF PLUTONIUM DIOXIDE-URANIUM DIOXIDE SOLID SOLUTIONS IN AIR AT 750 DEG C. Brett, N. H.; Fox, A. C. (Atomic Energy Research Establishment, Harwell, Eng.). J. Inorg. Nucl. Chem., 28: 1191-1203(May 1966). (AERE-R-3937).

Oxidation in air at 750°C of solid solutions of plutonium dioxide and uranium dioxide, (Pu, U)O_2, containing up to 80 mole % PuO_2, was studied. The reactions were followed analytically by measuring weight changes accompanying the oxidations and crystallographically, by x-ray powder methods. Variable solid-solution oxidation products were formed, either single-phase (cubic or orthorhombic) or two-phase (cubic + orthorhombic), according to the composition and physical state of the initial (Pu,U)O_2 solid solution. The cubic solid solutions were of the MO_{2+x} type with a wide composition range, 40 to 100 mole % PuO_2, while the orthorhombic solid solutions were of an M_3O_{8-x} type with a narrow composition range, 0 to 10 mole % PuO_2. No evidence was found for the formation of either pure PuO_2 or pure U_3O_8. Considerable cation mobility must occur during formation of two-phase oxidation products. An analytical and structural interpretation is given for the formation of variable oxidation products. (auth)

25494 CORROSION OF MAGNESIUM ALLOY FOR NUCLEAR REACTORS IN CARBON DIOXIDE. Ito, Goro; Ikeda, Seiichi (National Research Inst. of Metals, Tokyo). Trans. Nat. Res. Inst. Metals (Tokyo), 7: 196-207(Nov. 1965).

A compatibility study of Magnox AL 80 as fuel cladding of a reactor using carbon dioxide gas as coolant has been conducted under varied experimental conditions. Results indicated that the testing pressure up to 50 Kg/cm^2 has little influence on the corrosion penetration, while the effect of temperature especially above 500°C has been remarkably noted. Studies were also carried out to determine the tolerance limit of oxygen, nitrogen, and moisture content in the carbon dioxide gas to be used as coolant; and it has been found that a moisture content above 5% has deleterious effects. A remarkable increase in the penetration rate has also been observed when the experiment was carried out under the flow condition of carbon dioxide gas. At a flow rate of 100-500 cc/min of carbon dioxide gas, the corrosion rate was two fold higher than that obtained under static media of carbon dioxide. The effect on a welded specimen under the experimental conditions and also the creep-rupture properties of the alloy have been studied. The activation energy of the oxidation reaction and also the electron diffraction studies for different experimental conditions confirm the reaction mechanism and also the nature of the corrosion product. (auth)

25495 SYMPOSIUM ON ZIRCONIUM AND ITS ALLOYS. CORROSION PAPERS. Electrochem. Technol., 4: 77-162(Mar.-Apr. 1966). (CONF-651017).

Sixteen papers on corrosion presented at the symposium are collected. Separate abstracts were prepared for 11 of the papers. The remaining papers were previously abstracted for NSA. For abstract numbers of individual papers see CONF-651017 in the Report Number Index. (M.C.G.)

For abstracts of individual papers see: 24995, and 25496-25505.

25496 MECHANISM OF BREAKAWAY OXIDATION IN ZIRCONIUM ALLOYS. Greenbank, J. C.; Harper, S. (British Non-Ferrous Metals Research Association, London). Electrochem. Technol., 4: 88-92(Mar.-Apr. 1966).

The oxide films formed on several zirconium alloys in a variety of oxidizing atmospheres were studied in both pre- and post-breakaway conditions. It was suggested that breakaway occurred due to the mechanical failure of the oxide film under stresses generated in the growing film. The failure was such that in post-breakaway conditions the outer layer of oxide cracked progressively deeper, while the rate of oxidation was controlled by diffusion through the innermost uncracked oxide layer, which remained of constant thickness. (auth)

25497 OXIDATION KINETICS AND OXIDE FILM BREAKAWAY OF ZIRCONIUM AND ITS ALLOYS AT HIGH TEMPERATURES. Nomura, Sueo; Akutsu, Cho (Japan Atomic Energy Research Inst., Ibaraki-ken). Electrochem. Technol., 4: 93-9(Mar.-Apr. 1966).

The oxidation of Zr, Zircaloy-2, and Zr binary alloys with Cu, Ni, Sn, and Nb was studied with particular emphasis on the mechanism of the rate transition at 600 to 850°C in dry oxygen. The results obtained from continuous gravimetric measurements were compared with the oxide morphology involving hot-stage microscopy, x-ray and electron diffraction data, and electron-beam microprobe analysis of the oxide-metal interfaces. No close relation was found between the rate transition and either cracking or transformation of the oxide. A mechanism involving the recrystallization of the oxide is discussed, based on a consistent relation between the kinetic behavior and the behavior of the alloying elements during oxidation. Stability of anion vacancies in ZrO_2 was pointed out as an important factor determining the rate transition. (auth)

25498 OXIDATION OF ZIRCONIUM AND ZIRCONIUM ALLOYS IN WATER VAPOR ATMOSPHERES CONTAINING TRACE AMOUNTS OF OXYGEN AT 375 DEG AND 575 DEG C. Gulbransen, E. A.; Andrew, K. F. (Westinghouse Electric Corp., Pittsburgh). Electrochem. Technol., 4: 99-103(Mar.-Apr. 1966).

Kinetic studies were made on the reaction of water vapor with the following metals and alloys at 375 and 575°C: zirconium, Zircaloy II and IV, the eutectoid alloys Zr–1.6 wt % Cu and Zr–2.2 wt % Fe, and the zirconium–copper intermetallic alloys, Zr_2Cu (25.8 wt % Cu) and ZrCu (41.1 wt % Cu). The experiments were made in a flow-type reaction system. At 375°C, the eutectoid alloys oxidized faster than Zircaloy II and IV, while, at 575°C, Zircaloy II and IV oxidized faster than the eutectoid alloys. The intermetallic alloys oxidized 10 to 50 times faster than the dilute zirconium alloys. Hydrogen pickup was determined for each alloy as a function of oxygen weight gain. (auth)

25499 INFLUENCE OF THE STRUCTURE AND THE INTERSTITIAL IMPURITIES ON THE CORROSION OF ZIRCALOY-2 BY WATER AND STEAM. Armand, M.; Demars, H.; Givord, J. P.; Trolliet, G. (Societe d'Electrochimie d'Ugine, Albertville, France). Electrochem. Technol., 4: 104-8(Mar.-Apr. 1966).

The corrosion of Zircaloy-2 was studied to determine the influence of the interstitial elements oxygen and nitrogen. Tests were carried out in autoclave in steam at 350, 400, and 450°C and in water at 300°C for periods of 100 to 200 days. (auth)

25500 INFLUENCE OF INITIAL OXIDE-LAYER FORMATION ON THE HYDROGEN PICKUP OF ZIRCALOY. Debray, W.; Stieding, L.; Roesler, U. (Siemens-Schuckertwerke AG, Erlangen, Ger.). Electrochem. Technol., 4: 113-17(Mar.-Apr. 1966).

The autoclaving treatment of Zircaloy in 400°C steam, which is commonly used for corrosion inspection and handling protection of Zircaloy fuel canning tubes, results in a high hydrogen pickup fraction in pressurized water at least up to the transition point. Replacing this standard treatment by a two-step preoxidation (composed of a treatment in the temperature range from 200 to 300°C and autoclaving at 400°C) led to improvements in fractional hydrogen uptake by a factor of two, and additionally improved testing for nitrogen contaminations. The results contributed to the understanding of the mechanism of hydrogen uptake through the oxide, indicating surface control rather than bulk control for the hydrogen absorption of Zircaloy in the pretransition range. (auth)

25501 ANODIC FILM GROWTH ON ZIRCONIUM AT TEMPERATURES FROM 200 DEG TO 300 DEG C. Bacarella, A. L.; Sutton, A. L. (Oak Ridge National Lab., Tenn.). Electrochem. Technol., 4: 117-20(Mar.-Apr. 1966). (ORNL-P-1676).

Measurements of film growth on zirconium in oxygenated 0.05M H_2SO_4 at temperatures from 174 to 284°C can be represented by an hyperbolic sine function relating the anodic film growth current to the field strength. At the lower temperatures and small film thicknesses, the high field approximation was found adequate. The field coefficient B, was found to increase with temperature contrary to current theory, which predicts B to be an inverse function of temperature. The anomalous behavior can be rationalized with theory if local field concepts are employed, whereby the Lorentz local field is assumed to be the effective field acting on the mobile species. With this assumption, it was found that the activation dipole is constant and independent of temperature and the calculated activation distance is of reasonable magnitude. (auth)

25502 KINETICS AND MECHANISM OF OXIDE FILM GROWTH OF ZIRCONIUM. Pemsler, J. P. (Kennecott Copper Corp., Lexington, Mass.). Electrochem. Technol., 4: 128-31(Mar.-Apr. 1966).

Kinetics of oxide film growth on zirconium from 550 to 1300°C were measured. Between 550 and 650°C, film growth was approximately parabolic with an activation energy of 30 kcal/mole. Between 750 and 910°C, no normal rate law was obeyed; a rapid initial growth was followed by a much slower growth. At 975°C, coincident with void formation, the rate increased. Between 1100 and 1300°C, voids no longer formed and the rate became parabolic and rapid with an activation energy of 35 kcal/mole. Film growth behavior was correlated with a martensitic transition between monoclinic and tetragonal ZrO_2. (auth)

25503 HIGH-TEMPERATURE OXIDATION KINETICS OF ZIRCONIUM IN DRY OXYGEN. Hillner, E. (Bettis Atomic Power Lab., West Mifflin, Pa.). Electrochem. Technol., 4: 132-7(Mar.-Apr. 1966). (WAPD-T-1750).

The oxidation kinetics of two grades of pure zirconium were measured in the temperature range from 600 to 850°C. A compilation of previously reported data together with information generated in this study, indicated that the pretransition kinetic region can best be described by a cubic rate equation. The rate constant in $(mg/cm^2)^3/hr$ was calculated to be $k_c = 1.53 \times 10^{10} \exp[-45{,}450/RT]$, where 45,450 ± 1100 cal/mole is the activation energy for the reaction. A transition in oxidation kinetics from a protective to a less protective rate equation was found if sufficient time was allotted to the experiment. Expressions were generated for the temperature dependence of the weight gain and time to transition. The post-transition kinetics for high-grade sponge zirconium were found to be linear, whereas the parabolic rate equation best described the post-transition behavior of high-purity iodide crystal bar material. (auth)

25504 SOLUTE DISTRIBUTION IN OXIDIZED ZIRCONIUM ALLOYS. Greenbank, J. C.; Harper, S. (British Non-Ferrous Metals Research Association, London). Electrochem. Technol., 4: 142-8(Mar.-Apr. 1966).

The distribution of solute elements between metal and oxide was studied by electron-beam microanalysis of oxide films formed on Zr–1.7% Sn, Zircaloy-2, Zr–2½% Nb, Zr–5% Nb, Zr–3% Al, Zr–1% Cu, and Zr–½% Ru alloys in either steam or oxygen between 500 and 750°C. During oxidation in both steam and oxygen, the relatively reactive metals, Nb and Al, dissolved in the ZrO_2 with little alteration to the oxide structure. In the Zr–1% Cu alloy, copper was concentrated at the metal-oxide interface during oxi-

dation. Ruthenium was relatively insoluble in both metal and oxide. In oxygen corrosion the tin was completely soluble in the oxide, whereas in steam corrosion it was segregated either as a complex intermetallic particle (Zircaloy-2) or as a hydrated tin oxide (Zr–Sn alloys). (auth)

25505 THE INTERACTION OF IODINE WITH ZIRCALOY-2. Rosenbaum, H. S. (General Electric Co., Pleasanton, Calif.). Electrochem. Technol., 4: 153-6 (Mar.-Apr. 1966).

The corrosion of Zircaloy-2 exposed to I_2 vapor was studied. Two corrosion reactions were found to occur: a general attack and stress-corrosion cracking. When the surface of the alloy was protected by an adherent black oxide layer, the general attack was manifested in localized pitting. The morphology of the pits was found to be affected by cracks or other imperfections in the oxide layer. Stress-corrosion cracking occurred only when the alloy was exposed to both stress and the I_2 vapor simultaneously. Both the pitting and the cracking phenomena occurred at 300 to 400°C in a vacuum chamber filled with I_2 at ~0.4 torr. (auth)

25506 CORROSION OF ZIRCONIUM AND ZIRCALOY-2 IN FUSED KNO_3–$NaNO_2$–$NaNO_3$. Anderson, Larry L.; Hill, George Richard (Univ. of Utah, Salt Lake City). 40p. (CONF-651017-5). ORAU. Gmelin, AED-CONF-65-289-3.

From Electrochemical Society Meeting, Buffalo.

Results of a kinetic study of the corrosion of zirconium and Zircaloy-2 in 53% KNO_3–40% $NaNO_2$–7% $NaNO_3$ are reported. Data were obtained at temperatures between 400 and 600°C. The rate data were used to calculate activation enthalpies and entropies for the reactions. The product formed in the corrosion of both zirconium and Zircaloy-2 was ZrO_2. The effects of surface preparation and gas phase composition were studied. Mechanisms proposed to account for the experimental results and alternate mechanisms are discussed. (auth)

25507 METHOD FOR THE IMPROVEMENT OF THE CORROSION STABILITY OF ZIRCONIUM ALLOYS. Anderko, Kurt; Richter, Herbert; Schleicher, Hans-Walter (to EURATOM). German Patent 1,207,096. Dec. 16, 1965. Filed Mar. 23, 1961.

The resistance to corrosion of zirconium alloys was improved by annealing or hot-working above 640°C or by cold-working at ~50 to 60% at ambient temperatures or temperatures up to about 550°C and then subjecting them to a heat treatment between 500 and 630°C. (Gmelin Inst.)

Fabrication

25508 (AD–631423) APPLICATION OF SHEAR-SPINNING TECHNIQUES IN FORMING MOLYBDENUM MISSILE COMPONENTS. Rose, Charles H. (Watervliet Arsenal, N. Y. Benet R and E Labs.). Mar. 1966. 26p. (WVT–6604). CFSTI $2.00 cy, $0.50 mn.

The development of a spinning process for the manufacture of missile nose tips made of TZM molybdenum is reported. The design of preforms, tooling, and the manufacturing processes are explained. The complete material flow from rough sheet to finished nose tip is described. Results showed that shear-spinning is a feasible and practical method of producing hemispherical components from TZM material, and where a variable wall thickness is required, shear-spinning presents the only feasible method of manufacture. (auth)

25509 (AD–632831) DEVELOPMENT OF PRACTICE FOR COMPOSITE ROLLING OF STRUCTURAL METAL PANELS. Quarterly Report No. 1. Van Orsdel, J. R.; Bartlett, E. S.; Grube, K. R.; Ogden, H. R. (Battelle Memorial Inst., Columbus, Ohio). Apr. 1966. Contract DA-19-066-AMC-308(X). 27p. (AMRA-CR-66-02/1). CFSTI $2.00 cy, $0.50 mn.

Preliminary sandwich panels of vertical-rib design were prepared by the roll-welding process from maraging steel Inconel, and PH 14-8 Mo. Although complete bonds were not obtained in the first trials with these 3 materials, the results were encouraging, and do indicate that the process is adaptable to these materials. Refinement of cleaning techniques is necessary to produce satisfactory bonding. Leaching of the filler-bar material from the rolled panels containing the maraging steel must be investigated further before the applicability of this material can be determined fully. (P.C.H.)

25510 ((AERE-R–5097, Paper 3) EXPERIENCE OF VACUUM EVAPORATED TARGETS. Reynolds, J. B.; Boreham, D. (Atomic Energy Research Establishment, Harwell (England)). 6p.

Experience gained in preparing isotopic targets by vacuum evaporation using mainly resistance heating is reviewed. A collar with eight port holes for feeding services into commercial evaporation units is illustrated, and modifications made because of the very small quantities of isotopes used are outlined. A method for preparing reactive elements of isotopes used are outlined. A method for preparing reactive elements in the metal form and packing them in vacuum is described briefly. Preparation and stripping of unbacked and thin carbon backed targets are discussed. (A.G.W.)

25511 (AERE-R–5097, Paper 4) VACUUM EVAPORATION BY ELECTRON BOMBARDMENT. Arnison, G. T. J. (Atomic Weapons Research Establishment, Aldermaston (England)). 6p.

The salient features of each of several electron bombardment methods of both laboratory and commercial origin are given in tabular form. Another table compares the cost, maximum power required, focus method, and special advantages of the following types of guns: AWRE, Varian, Materials Research Corporation, Planer Unvala, Isotope, and T. V. (A.G.W.)

25512 (AERE-R–5097, Paper 5) PREPARATION OF THIN FILMS OF UO_2 AND PuO_2 BY VACUUM EVAPORATION. Povelites, John G. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). 7p.

UO_2 and PuO_2 film preparation takes place in conventional all-metal vacuum systems. The material is evaporated from a resistively heated tungsten boat clamped between water-cooled electrodes. Every part of the system exposed to radiation from the evaporating source is water-cooled. Rotation of the substrate results in films of more uniform density. When a film is to be made as nearly self-supporting as possible, nickel electroformed on a copper backing is used, and the copper is later dissolved in a stripping solution. Recently, carbon films are used as substrates for UO_2 and PuO_2 films. An electron gun made by Varian Associates is being used for a study of electron-beam heating. A deposit thickness meter of the vibrating quartz crystal type is used with the electron-beam system. Several identical films can be made at once by use of a planetary gear set. (A.G.W.)

25513 (AERE-R–5097, Paper 7) DEPOSITION OF UNIFORM EVAPORATED FILMS ON PLATES AND CYLINDERS. Mueschenborn, G. (European Atomic Energy Community, Geel (Belgium). Central Nuclear Measurements Bureau). 4p.

An arrangement for depositing uniform evaporated films of gold and indium on plates and cylinders of large surface area without great loss of evaporated material utilizes five sources arranged linearly. Calculations of the source arrangement were made, the assembly was installed, and experiments were done. A series of targets was fabricated with In in the thickness range of 0.1 to 2 mg/cm^2 and with Au between 1 and 10 mg/cm^2. Agreement between calculated and measured distribution lay within 0.3%. (A.G.W.)

25514 (AERE-R–5097, Paper 10) ELECTROSPRAY. Parker, W.; Gullholmer, W. (Chalmers Tekniska Hogskola, Goteborg (Sweden)). 2p.

A simple single-lens system for preparing thin layers of radioactive material by electrospraying is described. The

actual jet was contrived from a precision drawing pen unit. A weighted bore cleaner extended to the tip of the jet. The complete unit was screwed into a holder so that the jet was just level with the lens aperture. A backing holder of lucite was placed 5 to 6 cm from the spraying unit. Ethyl alcohol spraying solutions were used. Samples of Pu, Th, and U between 15 and 35 $\mu g/cm^2$ thick on Zapon backings were prepared. Near quantitative yields were obtained. (A.G.W.)

25515 (AERE-R-5097, Paper 11) ELECTROSPRAYING, VACUUM SUBLIMATION AND PAINTING. Glover, K. M.; Robinson, P. S. (Atomic Energy Research Establishment, Harwell (England)). 8p.

Electrospraying, vacuum sublimation, and painting are the three techniques most useful for preparation of radioactive sources from the actinide elements when only milligram quantities are available. Electrospraying can be used for both thin uniform sources and sources of 1 mg/cm^2. Overall deposition efficiency is about 75% and optimum source size is 8 to 14 mm diameter. Vacuum sublimation is the preferred method for preparing thin α sources. Painting is a tedious technique but useful for preparation of uniform deposits of up to 8 mg/cm^2 over areas of several square inches. Equipment and methods for all three techniques are described briefly. (A.G.W.)

25516 (AERE-R-5097, Paper 13) ELECTROPLATED ISOTOPIC TARGETS. Buford, F. A.; Freeman, J. H.; Reynolds, J. B. (Atomic Energy Research Establishment, Harwell (England)). 12p.

Electroplating is a suitable technique for the preparation of elemental isotopic targets of a variety of metals over a wide range of thickness. The method is basically simple and efficient and can be used for preparation of both backed and self-supporting foils. A high degree of uniformity can be obtained, and any unused isotope can be readily recovered. The factors governing the deposition process are discussed briefly, and the experimental procedures for a wide variety of elements are listed. (A.G.W.)

25517 (AERE-R-5097, Paper 14) PREPARATION OF THIN SELF-SUPPORTING ENRICHED IRON TARGETS. Gorodetzky, S.; Drouin, R. S. (Strasbourg Univ. (France). Institut de Recherches Nucleaires). 8p.

The method described for preparing iron targets by electrodeposition provides control of deposition, high yield recovery, low concentration, target homogeneity, and self support. Ammonium oxalate was used as the electrolyte at a pH of around 7. An average rate of electrodeposition was found to be 25 $\mu g/cm^2$/mamp/20 min. Targets enriched in ^{58}Fe with a minimum thickness of 20 $\mu g/cm^2$ were prepared. No contaminants were observed when the films were used as targets for nuclear experiments. (A.G.W.)

25518 (AERE-R-5097, Paper 15) PREPARATION OF α-ACTINIDE FOILS BY ELECTROLYSIS. Valentin, M.; Champion, J. (Commissariat a l'Energie Atomique, Fontenay-Aux-Roses (France). Centre d'Etudes Nucleaires). 2p.

Electrolytic procedures are given for preparing foils of uranium, neptunium, plutonium, americium, curium, californium, and their mixtures. Details of the procedures are different for different elements, but all require care to keep the solutions pure and the cell clean. The anode is made of platinum wire and the cathode of a corrosion resistant metal such as platinum, gold, stainless steel, nickel, or copper. Only slight deposits of curium and californium are obtainable. (A.G.W.)

25519 (AERE-R-5097, Paper 21) ROLLING AND PRESSING ISOTOPIC METALLIC FOILS. Reynolds, J. B. (Atomic Energy Research Establishment, Harwell (England)). 3p.

In the method described, a bead of the desired material is first prepared and pressed to a square or oblong shape not less than 0.020 in. thick. For hard metals it may be preferable to prepare a powder, press it immediately after reduction, and sinter it in vacuum at a suitable temperature. A strip of mirror finish stainless steel is used to sandwich the metal during rolling. Reduction is brought about gradually, and the material is annealed when necessary. Foils of isotopes of Cd, Ag, and Sn were rolled down to 1 mg/cm^2 with a little annealing. Cu, Fe, Ni, Pt, and Pd were rolled to 1 mg/cm^2 using frequent anneals. Factors influencing the limits of rolling are listed. Average thickness is measured by measuring the area of the foil and weighing, or more detailed measurements are made by attenuation of α particles. (A.G.W.)

25520 (AERE-R-5097, Paper 22) FABRICATION OF ULTRATHIN METALLIC FOILS. Karasek, Frank J. (Argonne National Lab., Ill.). 4p.

General procedures for fabrication of self-supporting metal foils down to a range of 1 mg/cm^2 or less are described. Equipment in use permits cold rolling directly to 0.15 mm; a modification of the commercial method of pack rolling is used for thinner foils. Natural foils are prepared when possible from commercially available sheet or foils; reprocessing of isotopic materials is usually necessary. Important factors in successful rolling of foils include cleanliness, reduction per pass during pack rolling, and amount of cold work present in the stock used in the making of rolling packs. Specific problems encountered in fabrication of foils of ^{24}Mg, Ti isotopes, and Zr isotopes are discussed briefly. (A.G.W.)

25521 (AERE-R-5097, Paper 23) HIGH FREQUENCY LEVITATION HEATING AND ITS APPLICATIONS TO: 1. EVAPORATION OF THIN LAYERS, AND 2. PREPARATION OF HOMOGENEOUS Al ALLOYS. Van Audenhove, J. (European Atomic Energy Community, Geel (Belgium). Central Nuclear Measurements Bureau). 8p.

Equipment for vacuum evaporation of metals by high-frequency levitation heating is described. Two sizes of coils are used: with the large coil, quantities from one gram down to 100 mg of Al, Ag, Ti, Co, Cu, and U can be levitated and remain in a stable molten drop form allowing evaporation in vacuum; with the minicoil, stable evaporations with starting quantities of 3 mg upwards can be realized. Layers of 50 to 100 $\mu g/cm^2$ with a homogeneity of about 1.7% are obtained on substrates with a diameter of 50 mm. The efficiency is poor, but part of the metal can be recovered. Equipment used for preparation of Al alloys by levitation melting is also described. Ten-gram amounts of Al alloys with 0.1 to 5% of Au, Ag, Mn, Co, B, Ir, Rh, Lu, or Dy and with 1 to 24.5% ^{235}U were prepared by melting and casting in an argon atmosphere at 300 torr. The method is highly quantitative and good homogeneity is obtained. (A.G.W.)

25522 (ANL-7075) NUCLEAR-FUEL-ELEMENT LOADING BY VIBRATORY COMPACTION: URANIUM-PLUTONIUM CARBIDE SPECIMENS FOR EBR-II IRRADIATION. Ayer, J. E.; Soppet, F. E.; Talaber, G. J.; Bieler, B. H. (Argonne National Lab., Ill.). Feb. 1966. Contract W-31-109-eng-38. 17p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

The results of fabrication by vibratory compaction of the first of a series of fuel specimens are presented. The PuC–UC specimens made for this study were jacketed in eight different alloys. The fuel rods were manufactured by an infiltration technique developed at ANL. The loading conditions were derived from basic information gathered on a model system. Eleven mixed-carbide rods were made, ten of which were loaded to 80% theoretical density (TD) with 80 wt % UC and 20 wt % PuC. The fuel bodies were low in both density and PuC in the upper 2 in. of the column. One mixed-carbide specimen, compacted to 83.8% TD and containing 19.3% PuC, was more uniform in density and Pu distribution than the ten based upon the model system. Five fuel specimens containing solid-solution UC–PuC were fabricated by the infiltration technique to the highest density practicably attainable. The five specimens showed uniform density and fuel distribution. The density of the fuel columns was 84.2 ± 1.3% of TD attained with 97.1% TD particles compacted into 6.5-mm-ID jacket. (auth)

25523 (EURAEC-1277) METHODS FOR THE MANUFACTURE OF PRESSURE VESSELS. Quarterly Report

No. 12, January 1–March 31, 1965. (Neratoom, N. V., The Hague (Netherlands)). Contract 069-61-12-RD N. 76p. (EUR-2080). Dep. mn; CFSTI $3.00 cy, $0.75 mn.

Work Performed under United States–Euratom Joint Research and Development Program.

Results of studies on the welding of thick steel plates by various methods are presented. The results include: examination of a seam arc-welded with a single welding head under a powder cover, report on arc-welding with single and double heads under a powder cover, tests results and photographs of a seam gas-shielded arc-welded under CO_2, and microphotographs of a seam welded with the boxed CO_2 method. (W.L.G.)

25524 (EURAEC-1562) A STUDY ON RESIDUAL STRESSES SET UP BY THE VERTICAL RISE WELDING PROCESS. Final Report No. 1. (Arcos, S. A., Brussels (Belgium)). [1964]. Contract 053-61-12-RDB. 71p. (EUR-2801). Dep. mn. CFSTI $3.00 cy, $0.75 mn.

Work Performed under United States–Euratom Joint Research and Development Program.

Measurements were made of the distribution and magnitude of residual stresses generated by the electrogas and electroslag welding processes. The distribution of stresses was generally the same as in conventional welding processes. The magnitude of the stresses generated by the electrogas or electroslag process is approximately equal. The major advantages of these two processes over conventional methods appear to be that the deposited metal is practically continuous and that the base metal is subjected to plastic deformation from only one heating cycle. (W.L.G.)

25525 (ORNL-TM-1501) REMOTE FABRICATION OF THORIUM FUELS. Sease, J. D.; Pratt, R. B.; Lotts, A. L. (Oak Ridge National Lab., Tenn.). Apr. 1966. Contract W-7405-eng-26. 23p. (CONF-660524-2). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From 2nd International Thorium Fuel Cycle Symposium, Gatlinburg, Tenn.

To fabricate large quantities of recycled ^{233}U and thorium fuel, remote fabrication is required because of the penetrating radiation caused by the presence of ^{232}U in ^{233}U. The problems of remote fabrications are outlined and the approach taken at ORNL to develop suitable systems for remote fabrication is described. This is illustrated by a discussion of the oxide fabrication line that was designed for operations in the heavily shielded Thorium–Uranium Recycle Facility now under construction. The design and development of a remote fueled-graphite fabrication line, which is now in progress, is also discussed briefly. An economic analysis of the consequences of remote fabrication is also included. This analysis shows that the ratio of the cost of remote-to-hooded fabrication is inversely related to plant capacity. (auth)

25526 MANUFACTURE OF FUEL ELEMENTS IN FRANCE. Energ. Nucl., 8: 114-23(Mar.-Apr. 1966). (In French).

Three families of fuel elements make up the main part of the activity of the atomic fuel industry in France. They are: metallic uranium fuel elements, oxide fuel elements, and plate fuel elements. The present state of each of them is then described. (auth)

25527 PREPARATION OF THIN FILMS OF TANTALUM AND PROTACTINIUM BY ELECTRO SPRAYING. Muzzarelli, R. A. A. (Univ. of Sherbrooke, Can.). Inorg. Nucl. Chem. Lett., 2: 1-3(Jan. 1966).

In order to prepare thin targets of protactinium oxide and tantalum oxide using the electro-spraying technique, it is necessary to have protactinium or tantalum in organic solution. Because it is simple to dissolve the oxide with hydrofluoric acid, it appeared convenient to extract protactinium or tantalum from a hydrofluoric acid solution or to mix this solution with organic solvents. Thin films whose characteristics corresponded to the requirements (100 μg and 4 mg/8 cm^2) were prepared by adding 1 ml of mesityl oxide to 1 ml of 1N HF in acetone containing 5 mg of tantalum or protactinium. (M.C.G.)

25528 PRODUCTION OF SPHERICAL URANIUM NITRIDE PARTICLES USING THE FLUIDIZED-BED TECHNIQUE. Naumann, D.; Heyne, W.; Burk, W. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Kernenergie, 9: 50-4(Feb. 1966). (In German).

Basic data of a technique to produce spherical uranium-nitride particles were obtained in laboratory studies. An apparatus of quartz glass fit for this purpose was developed and tested. It contains a bed of pre-formed crystalline uranium nitride powder that is fluidized by a gaseous mixture at high temperature. The aqueous mixture consists of both the reactants UCl_4–steam and ammonia and a carrier gas. For suitable conditions, the uranium nitride is precipitable on the seed particles from the gaseous phase. The particles reach an approximately spherical form. The spherical grains of composition $UN_{1.7}$ give the stoichiometric mononitride of uranium and the particles retain their form and a smooth surface. (auth)

25529 TIME LAW OF THE SIZE REDUCTION OF TUNGSTEN CARBIDE. Exner, H. E.; Fischmeister, H. F. (Schwedische Institut fuer Metallforschung, Stockholm). Planseeber. Pulvermet., 14: 3-14(Apr. 1966). (In German).

By means of a simple model, a time law for the size reduction of brittle materials during grinding was derived, which agrees with results of grinding studies on tungsten carbide. Variations in the grinding conditions affected the rate constant but not the exponent so that the time law in its general form $s^2 - s_0^2 = k^2 \cdot t$, should apply to the size reduction of tungsten carbide for any grinding conditions. This law was verified on the basis of new data and provides a means of determining in advance the grinding time required for obtaining a certain carbide grain size. (auth)

25530 PRODUCTION OF URANIUM, THORIUM, AND PLUTONIUM AND THEIR COMPOUNDS. Barghusen, J. J.; Nelson, P. A. Reactor Fuel Process., 9: 51-64(Winter 1965–1966).

The recovery of uranium from ores by hydrometallurgical techniques is described. Production of UO_3, conversion of UF_6 to UO_2 and U_3O_8, reduction of higher oxides to UO_2, reduction of UF_4 by cut-crown magnesium, reduction of UO_2 by calcium, electrolytic production and refining of uranium, preparation and properties of PuO_2, production and purification of plutonium metal, production and properties of UC and PuC, preparation of UN and PuN, preparation of US and PuS, and preparation of UP and PuP are discussed. (69 references). (M.C.G.)

25531 MINI-CAM TRACER PLATE (Engineering Materials). (Los Alamos Scientific Lab., Univ. of California, N. Mex.). (CAPE-1356).

5 drawings.

The tracing device described, which is used on a tracer lathe, can be set with gauge-block accuracy to guide the tracer stylus through any desired arc or along any angled path. It can be used with templets for more complex shapes. It can be adapted to any tracer lathe equipped with a control stylus and normally used with templets. The tracer plate is mounted in place of a templet. The device is used in convex and concave radii, and angular or conical shapes. Although the best applications are fairly simple contours, it eliminated about 90% of the templets needed for machining in three years of use at the Los Alamos Scientific Laboratory. (For details, see TID-4100.) (F.L.S.)

25532 SYMPOSIUM SUR LA METALLURGIE DES POUDRES, PARIS, JUIN 1964. (Symposium on Powder Metallurgy, Paris, June 15–17, 1964). Saint-Germain-en-Laye, France, Editions Metaux, [1965]. 448 p. FF 120; DM 100; £ 8.16.0; $25.00. (CONF-6401618).

Thirty articles are included; separate abstracts were prepared for 13. One article on material transport mechanism in sintering was previously abstracted in NSA as 19: 20465. The remaining 16 articles include information on: application of sintered pieces; characteristics and com-

pressibility of powders; problems of sintering in the solid phase; problems in sintering in the fluid phase; and properties of sintered pieces. (P.C.H.)

For abstracts of individual papers see: 25533–25541, and 25598–25601.

25533 CHARACTERIZATION OF BERYLLIUM POWDER. Butcher, J. W.; Lowe, J. N. (Atomic Weapons Research Establishment, Aldermaston, Eng.). pp 53-64 of Symposium sur la Metallurgie des Poudres, Paris, Juin 1964. Saint-Germain-en-Laye, France, Editions Metaux, [1965].

The effects of particle-size distribution and chemical composition on the compaction characteristics of three different commercial beryllium powders were studied. Experimentally, it was difficult to vary the particle size without altering the composition, but nevertheless it was found that the hot pressability of a powder was almost entirely a function of its chemical composition. An experiment using a silicate-impregnated mold showed an increase in hot pressability, later attributed to silicon contamination. The addition of silicon to the Pechiney powder, which is characterized by a low impurity content and compactability, was also studied. An optimum addition of 500–750 ppM silicon produced a powder with improved and reproducible hot pressability, as defined by the length to diameter ratio of a compact having over 98% theoretical density; this ratio increased from less than 1 to more than 2. The beneficial effects of silicon were restricted to compaction in vacuum, at temperatures above 1050°C: it is suggested that the consolidation mechanism may involve the formation of a liquid phase at the Be–Si eutectic (mp 1090°C). (auth)

25534 PRESSURE SINTERING OF ACTIVATED BERYLLIUM POWDER. Butcher, J. W. (Atomic Weapons Research Establishment, Aldermaston, Eng.); Samuel, R. L. pp 65-74 of Symposium sur la Metallurgie des Poudres, Paris, Juin 1964. Saint-Germain-en-Laye, France, Editions Metaux, [1965].

Activation was induced by adding from 500 to 750 ppM of silicon to beryllium powder during ball-milling. Improved results were obtained by producing an equivalent amount of silicon in situ by reaction between silica and aluminium. The activation results showed: higher density on sintering at 1100°C before pressing; improved degree of particle flow during hot pressing at 1 ton/in^2 which resulted in increased length to diameter ratio at maximum density; and migration of inclusions from intergranular positions to boundary triple points, accompanied by a further densification. The mechanism of activation is discussed; in particular, the effect of introducing high-valency ions of small atomic size in oxide films. The significance of the present results and the application of this type of pressure sintering to other metals are also discussed. (P.C.H.)

25535 INFLUENCE OF IMPURITIES AND OF THE GRANULOMETRY IN THE SINTERING OF BERYLLIUM. Logerot, J. M.; Syre, R. (Compagnie Pechiney, Chambery, France). pp 75-88 of Symposium sur la Metallurgie des Poudres, Paris, Juin 1964. Saint-Germain-en-Laye, France, Editions Metaux, [1965]. (In French).

The application of powder-metallurgy methods to beryllium has led to a number of observations regarding the special sintering conditions involved and the influence of certain parameters on the sinterability, and the physical and mechanical properties of the final products. Attention is first directed to the method of manufacture of the powder, starting from electrolytic flakes, and the properties of the beryllium powders chiefly used in Europe. The effect of the principal properties of the powders which have within the scope of present practice of control (chemical purity in metallic elements, the insoluble compounds, or the gases, the maximum and minimum grain size) is studied from the viewpoint of: sinterability of the powder; conditions governing further treatment of the sintered compacts; and mechanical properties of the semi-finished sintered products treated under the same conditions. (auth)

25536 CRYSTAL GROWTH BY SINTERING OF HIGH-TEMPERATURE OXIDES. Oel, Heribert J. (Max-Planck-Institut fuer Silikatforschung, Wuerzburg, Ger.). pp 129-40 of Symposium sur la Metallurgie des Poudres, Paris, Juin 1964. Saint-Germain-en-Laye, France, Editions Metaux, [1965]. (In German).

The properties, uses, and production of oxide ceramics are discussed. A method is described by which crystallite size distribution was determined from metallographic sections. A particle-size analyzer was used to measure the area of the cross-section of the individual crystallites exposed in the metallographic section. The size-distribution function so obtained was converted to crystallite-size data. These were ascertained for various times of sintering and used for calculating the rate of crystal growth. At the same time thermodynamic and kinetic conceptions were applied to formulate an equation for crystal growth containing expressions for the interface energy (γ) and the coefficient (u_K) for the material transfer through grain boundaries. The equation is in agreement with the experimental results. The results obtained are of interest not only for the oxides studied and others, but also for metals, carbides, and other crystalline substances. At the present, it is assumed that the equation proposed for crystal growth is generally valid for the crystal growth of polycrystalline materials unless uniform growth is prevented by internal stresses or other factors. (P.C.H.)

25537 THERMAL ASPECTS, FINAL DENSITY, AND RESIDUAL POROSITY IN SINTERING OF PURE OXIDES OF URANIUM AND BERYLLIUM. Caillat, R. (CEN, Saclay, France. CEN, Grenoble, France). pp 167-87 of Symposium sur la Metallurgie des Poudres, Paris, Juin 1964. Saint-Germain-en-Laye, France, Editions Metaux, [1965]. (In French).

The results described serve to underline the importance of rapid heating to the sintering temperature in the case of pure oxides of Be and U. Compacts made from uranium oxide powders, with a specific surface area of 10 m^2/g reached 95% of theoretical density in a few minutes at 1,500°C under dry hydrogen. In some cases, the porosity was then strictly confined to the grain boundaries. This particular texture was very stable thermally. The intergranular porosity and grain-growth were not essentially affected by subsequent heating. In the conditions under which this texture was formed, a rise in the sintering temperature may result in a lowering of the final density. With beryllium oxide powders prepared from the sulfate with a specific surface area of 10 m^2/g, a rapid approach to the sintering temperature was particularly effective under dry hydrogen. Densification was also very rapid. The results obtained on sintering of the two oxides were compared. They suggest that particular importance should be attached to the chemisorbed phases and to grain-boundary diffusion in the sintering of both compounds. (auth)

25538 EXTRUSION-SINTERING OF MIXTURES OF URANIUM AND GRAPHITE POWDERS. Lamotte, M.; Whitwham, D.; Herenguel, J. (Societe Trefimetaux, Paris). pp 199-226 of Symposium sur la Metallurgie des Poudres, Paris, Juin 1964. Saint-Germain-en-Laye, France, Editions Metaux, [1965]. (In French).

Starting with a fine uranium powder (particle-size ≃ 15 μ), the required conditions for extrusion-sintering of high-density bars (>97% of theoretical density) were determined. The method consisted of extrusion-sintering the highly pyrophoric powder within a copper container sealed under vacuum. The same technique was also applied to the preparation of high-density bars of uranium monocarbide (4.8% carbon), starting from a suitable mixture of uranium and graphite powders. As the proportion of graphite increased the conditions for satisfactory sintering become narrower. However, up to 3% graphite, the extruded bars sintered to high-density and, in addition, the reaction U + C → UC was realized by simple heat-treatment to form a compact cermet U + UC. Fineness of structure depended essentially on the particle size of the initial powders and very little on the temperature of the heat-treatment. When the car-

bon content increased above 4% and, particularly, on approaching the stoichiometric mixture, the extrusion operation became quite difficult to control and, in addition, the reaction U + C → UC was accompanied by a considerable loss of compacity. These problems were overcome by controlling the following inter-dependent factors: particle-size of the powders, temperature, and extrusion ratio. The second difficulty met with was development of very serious porosity during the reaction U + C → UC. This was eliminated by carrying out the reaction under compression. Finally, the practical implications of the study are discussed. (P.C.H.)

25539 REACTIONS OF CARBIDES AND NITRIDES OF TRANSITION METALS WITH B ELEMENTS AND SYNTHESIS OF COMPLEX COMPOUNDS. Nowotny, H.; Jeitschko, W.; Benesovsky, F. (Univ., Vienna. Metallwerk Plansee, Reutte/Tyrol, Austria). pp 239-58 of Symposium sur la Metallurgie des Poudres, Paris, Juin 1964. Saint-Germain-en-Laye, France, Editions Metaux, [1965]. (In German).

On the basis of the properties and interactions of the well known NaCl-type transition-metal monocarbides and mononitrides, the powder-metallurgical ternary carbides U (Cr, Mo, W) C_2 as well as UBC and Mo_2BC are discussed from the aspect of the octahedron structure (T_6X). Conditions are described for the production of complex carbides or nitrides of the composition T_3M_2X (with saturated β-Mn structure), T_2MX (H phase) and T_3MX (perovskite-type), which are crystallochemically recognizable by a mutual octahedral structure (T_6X). There is accordingly a uniform group of compounds including the new complex carbides and nitrides of the η-carbide type or of partly saturated M_5Si_3 type, many of which are difficult or impossible to prepare by melting, but can be produced by sintering. (P.C.H.)

25540 INFLUENCE OF PROCESSING CONDITIONS ON THE PROPERTIES OF SILVER-INFILTRATED TUNGSTEN. Goetzel, Claus G.; Rittenhouse, John B. (Lockheed Missiles and Space Co., Palo Alto, Calif.). pp 279-88 of Symposium sur la Metallurgie des Poudres, Paris, Juin 1964. Saint-Germain-en-Laye, France, Editions Metaux, [1965].

In order to achieve optimum end use performance of the composite all of the manufacturing processing variables must be controlled and carefully optimized. However, two of these processing variables have the most significant bearing upon the ultimate properties. One of these is the tungsten powder particle size which most apparently influences ultimately the matrix density, permeability, tensile strength, and tensile modulus of elasticity. The other is the infiltration temperature and infiltrant feeding technique which significantly influence the composite tensile strength, which must be about 33,000 lbs per square inch 1500°F (825°C), and the thermal conductivity, which must be high enough to minimize thermal stresses. The infiltration process also influences the final porosity of the infiltrated composite. Ideally all pores should be perfectly filled. Practically this is not possible and the ideal condition is at best only approached. However, the soundness of the composite is the basis of its accept-reject criterion. Porosity, void agglomerations, or defects in the infiltrated part, as determined by ultrasonic inspection, are limited to $\frac{5}{64}$ in. (2 mm). Correlation tests showed that the ultrasonic soundness of the composite has a direct bearing upon its end use performance. (auth)

25541 SINTERING, IN PRESENCE OF A LIQUID PHASE, OF URANIUM–URANIUM MONOCARBIDE CERMETS. Rousset, P.; Accary, A. (CEN, Saclay, France). pp 289-303 of Symposium sur la Metallurgie des Poudres, Paris, Juin 1964. Saint-Germain-en-Laye, France, Editions Metaux, [1965]. (In French).

By micrographic and granulometric studies, it was found that porous cermets of uranium–uranium monocarbide can be sintered, by a simple straightforward process, to a density approaching the theoretical value, if the sintering is carried out at a temperature above the melting point of uranium. This phenomenon is accompanied by an evaporation of uranium which varies very little whether sintering is conducted under vacuum or in argon, and is largely dependent upon the free uranium content; this evaporation practically ceases in cermets containing 4% by weight of carbon. Micrographic studies of the cermets obtained provided evidence of a mechanism of grain growth of the carbide based on the seamless welding of several grains. Moreover, a granulometric study of the carbide showed that the mean grain size tends to increase as the duration and temperature of sintering are raised. (auth)

25542 IMPROVEMENTS IN OR RELATING TO THE MANUFACTURE OF URANIUM/ZIRCONIUM CARBIDE. Wheatley, Christopher Cameron Hope; Thorpe, Tom (to United Kingdom Atomic Energy Authority). British Patent 1,023,157. Mar. 23, 1966. Filed Sept. 6, 1962.

A method is described for producing a high purity U/Zr carbide that is suitable for use as a cathode in a diode for a nuclear reactor for the direct conversion of fission heat to electric power. A mixture of UC and ZrC in the proportions of 67 and 33 wt %, respectively, are ground together for a period of 7 to 20 hours to a particle size of less than 5μ. The ground mixture is pressed at a pressure in excess of 5 ton/in^2 and then heated in one or more stages in vacuo to a temperature in excess of 1800°C. At all times until the completion of the firing, the concentrations of O_2 and H_2O in the atmosphere must be less than 30 and 150 ppM, respectively. (B.L.M.)

25543 IMPROVEMENTS RELATING TO THE MANUFACTURE OF FINNED TUBING. Chapman, Thomas Edwin (to Fairey Engineering Ltd.). British Patent 1,023,822. Mar. 23, 1966. Filed Feb. 10, 1961.

A die-stamping process is described for the fabrication of a finned metal tube with a pattern of integral external fins. The workpiece is surrounded with a ring of inwardly directed former dies having on the nose of each die a deep slot or group of several such slots spaced apart in parallel relationship. The slot pattern on the noses of the ring of dies corresponds to the required circumferential fin pattern or a part of the pattern. The noses of the dies are stamped into the work piece by a single thrust or blow or multiple thrusts or blows to form a ring of fins around the workpiece. The dies are then all withdrawn clear of the workpiece, the workpiece is advanced axially relatively to the ring of dies, and the stamping process repeated to form a second ring of fins around the workpiece. (B.L.M.)

25544 IMPROVEMENTS IN OR RELATING TO BRAZING ASSEMBLIES. Purchas, John Guy (to United Kingdom Atomic Energy Authority). British Patent 1,025,846. Apr. 14, 1966. Filed Sept. 7, 1962.

A brazing assembly that is particularly, but not exclusively, applicable to a plate type fuel element includes a number of plates arranged in a spaced relationship, a side member to which the edges of the plates are to be joined, and a hollow spacer member between each pair of plates. Each spacer forms a reservoir for braze material, is substantially U-shaped in cross section, has one limb extended for insertion between a plate and the side member, and is apertured so that the braze material forms a capillary film at the brazing temperature and flows between the components being joined. The spacer is so formed that a coolant flowing through a fuel element may flow adjacent to the brazed edge of the fuel plate. (B.L.M.)

25545 METHOD FOR THE PRODUCTION OF COARSE-CRYSTALLINE STOICHIOMETRIC URANIUM DIOXIDE. Scott, John Jackson; Turnbull, Neil Claude (to Norton Co.). German Patent 1,207,928. Dec. 30, 1965. Priority date June 6, 1963, United States.

Uranium dioxide is produced by melting a mass of raw material having a mole ratio O:U ≤ 3. The method given consists of steps for circulating an inert gas through the mass to expel all other gases, for circulating hydrogen until the mass is turned into stoichiometric uranium dioxide, and for cooling down. (Gmelin Inst.)

25546 METHOD AND DEVICE FOR THE PRODUCTION OF PURE SINTERABLE URANIUM MONOCARBIDE POWDER. Blum, Pierre; Moreau, Claude (to Commissariat a l'Energie Atomique). German Patent 1,208,297. Jan. 5, 1966. Priority date Aug. 5, 1959, France.

The method consists of heating fine-grained uranium powder in an inert gas atmosphere at 700 to 900°C, reacting the heated powder with gaseous hydrocarbons, and heating the product obtained in vacuum or an inert atmosphere for 3 to 5 hours. The process is carried out in a drum rotating about its axis in alternating directions and positioned within an enclosed container. (Gmelin Inst.)

25547 METHOD FOR THE PRODUCTION OF SINTERABLE URANIUM DIOXIDE. Verkerk, Barend (to N. V. Philips' Gloeilampenfabrieken). German Patent 1,208,743. Jan. 13, 1966. Priority date June 30, 1959, Netherlands.

The uranium dioxide obtained by reduction of uranium compounds at about 700 to 1000°C is treated in an oxidation process at about 700 to 1000°C in an atmosphere free from oxygen and containing water vapor until a product between $UO_{2.02}$ and $UO_{2.08}$ is obtained. (Gmelin Inst.)

25548 METHOD FOR THE PRODUCTION OF URANIUM CARBIDE SINGLE CRYSTALS IN HIGH VACUUM AND EQUIPMENT FOR CARRYING OUT THIS METHOD. Beucherie, Pierre; Gerard, Joseph (to EURATOM). German Patent 1,212,050. Mar. 10, 1966. Filed June 15, 1962.

Uranium monocarbide crystals are grown in vacuo from vapor by evaporating uranium monocarbide in an inductively heated container of uranium monocarbide and condensing the vapor on cooled surfaces within the container. (Gmelin Inst.)

25549 METHOD FOR THE PRODUCTION OF URANIUM. Delange, Maurice; Holder, Jean; Huet, Henri; Sauteron, Jean; Vertes, Paul (to Commissariat a l'Energie Atomique). German Patent 1,212,303. Mar. 10, 1966. Priority date Nov. 13, 1963, France.

Uranium is produced by reducing uranium tetrafluoride with magnesium. The reduction is carried out directly in a mixture of uranium tetrafluoride, with a density of about 1.5 to 2 g/cm^3 and high activity, and magnesium grains. The reduction is initiated by heating to a temperature of about 600°C. (Gmelin Inst.)

25550 METHOD OF PRODUCING REFRACTORY BODY BONDED BY AN ALUMINUM NITRIDE–ALUMINUM BORIDE COMPOSITION. Grulke, Carl A.; Ruggiero, James D. (to Union Carbide Corp.). U. S. Patent 3,236,663. Feb. 22, 1966. Filed July 19, 1961.

A method of producing a refractory body bonded by Al_3N_3–AlB composition comprises mixing particulate BN having a purity by weight of at least 98%, particulate Al metal, and at least one particulate refractory material; molding the mixture into a desired shape; and firing the mixture at between 1375 and 1500°C in a reducing atmosphere for a time sufficient to produce a bond of Al_3N_3 and AlB. The refractory material is selected from the group consisting of BN, Al_2N_3, TiB_2, ZrB_2, graphite, SiC, TiC, and C and constitutes from an effective amount up to about 90 wt % of the mixture. The weight of the Al metal in the mixture is from 1 to 3 times greater than the weight of the BN. (B.L.M.)

25551 METHOD OF MAKING HIGH STRENGTH NUCLEAR REACTOR ELEMENTS. Sermon, George T. U. S. Patent 3,236,921. Feb. 22, 1966. Filed Jan. 15, 1962.

A method is described for producing reactor fuel and blanket elements in which the fissile or fertile material is dispersed throughout the matrix material. Particulate coal tar pitch having a B content of about 0.2 ppM by weight is mixed with high purity graphite having a B content of only about 0.02 ppM by weight in the proportions of 20–50 wt % pitch to 80–50 wt % graphite; the mixture is heated to the temperature range of 110–165°C to substantially solidify it; and the mixture is then broken into particle size. This particular material is mixed with a substance consisting of fertile and fissionable material having a B content of about 5 ppM by weight, and the resulting mixture is pressure molded into suitable shape. The molded body is slowly heated to the graphitization temperature range. The elements produced by this method do not readily corrode, are highly thermally conductive, exhibit a high resistance to thermo-shock, and can withstand extremely high temperatures. (B.L.M.)

25552 COLUMBIUM BRAZING ALLOY. Javorsky, Charles A.; Howe, John S. Jr. (to U. S. Atomic Energy Commission). U. S. Patent 3,239,334. Mar. 8, 1966.

An alloy was developed for brazing niobium to yield bonds having high strength and retaining high strength at high temperatures. The alloy has a titanium base, with 17 to 23 wt % niobium, 10 to 11 wt % vanadium, 8 to 10 wt % chromium, and 2 to 3 wt % aluminum. (AEC)

25553 DIFFUSION BONDING OF TUNGSTEN TO TUNGSTEN. Batista, Roy I.; Hanks, G. S.; Murphy, D. J. (to U. S. Atomic Energy Commission). U. S. Patent 3,241,230. Mar. 22, 1966.

A method of diffusion bonding tungsten to tungsten by forming a layer of an interfacial material (WO_3, Mo, W, Mo–W, C, Ni, or Ni–Re) at the surface to be contacted and applying an axial pressure above 1000 psi at temperatures above 1700°C is described. (AEC)

25554 HIGHLY DENSIFIED AND MACHINABLE TUNGSTEN–IRON–NICKEL ALLOY. Neeley, A. C. (to U. S. Atomic Energy Commission). U. S. Patent 3,241,955. Mar. 22, 1966.

A tungsten-base alloy is described that consists essentially of 0.3 to 0.5 wt % Ni; 0.8 to 1.1 wt % Fe, and the remainder tungsten. (AEC)

25555 CARBON COATED METAL CARBIDE PARTICLES FOR NUCLEAR REACTOR USE. Goeddel, Walter V. (to U. S. Atomic Energy Commission). U. S. Patent 3,243,349. Mar. 29, 1966.

A metal carbide particle with an outer protective coating of carbon, which has increased thermal stability at high temperatures (on the order of 2000°C) is described. The particle comprises a body of metal carbide of the highest carbide form, and includes unbound carbon that ~ equals the saturation concentration for the high temperature to which the particle will be exposed during use. (AEC)

25556 TANTALUM BRAZING ALLOY. Armantrout, Clo E.; Howe, J. S. Jr.; Javorsky, C. A. (to U. S. Atomic Energy Commission). U. S. Patent 3,249,429. May 3, 1966.

A method is described for brazing tantalum and tantalum base alloys with the composition 15 to 25 wt % titanium, 3 to 7 wt % niobium, 2 to 4 wt % tungsten, and remainder tantalum. Exceptional ductility and superior oxidation resistance with respect to tantalum is possessed by the alloy. (AEC)

25557 NUCLEAR FUEL PARTICLES COATED WITH MIXTURE OF PYROLYTIC CARBON AND SILICON CARBIDE. Blocher, John M. Jr. (to U. S. Atomic Energy Commission). U. S. Patent 3,249,509. May 3, 1966.

A method is described for fabricating a coated nuclear fuel particle comprising a core of ceramic fissionable fuel material, with a layer of substantially pure pyrolyzed carbon and a layer of pyrolyzed carbon containing silicon carbide concentrically surrounding it. The core and the layer of substantially pure pyrolyzed carbon are so arranged as to define a void space therebetween. (AEC)

Properties and Structure

See also CHEMISTRY — Inorganic and Physical Chemistry
PHYSICS — Solid State Physics

Refer also to abstract 25532.

25558 (AERE-R-5097, Paper 30) DENSITY AS A NON-DESTRUCTIVE MEASURE OF COMPOSITION OF U/Al ALLOYS. Van Audenhove, J.; Brulmans, J. (European Atomic Energy Community, Geel (Belgium). Central Nuclear Measurements Bureau). 10p.

Samples of Al alloys containing 20, 22, 24, and 24.5% U by weight were prepared by levitation melting. Densities of the samples were determined by a combination of the float method with hydrostatic weighing. Densities were computed from the amounts and densities of the phases present. Computed and measured densities of Al, α Al, UAl_4, and Al alloys containing 20, 22, and 24 wt % U are tabulated and plotted for natural and enriched U. It is concluded that it is possible to obtain a reproducibility in density up to 0.0004 g/ml for different samples containing the same U content. (A.G.W.)

25559 (AWRE-O-19/66) THE PERMEATION AND DIFFUSION OF HYDROGEN ISOTOPES THROUGH STEELS. PART 3. MARAGING STEEL. Jones, P. M. S.; Gibson, R.; Evans, J. A. (Atomic Weapons Research Establishment, Aldermaston (England)). Apr. 1966. 22p. Dep. BIS $1.10. HMSO 5s. 6d.

Studies were made on the permeability, diffusion, and solubility of deuterium and hydrogen in maraging steel. The results obtained were: $P_{H_2} = 0.093 \exp(-11100/RT)$std ml cm^{-2} s^{-1} $atm^{-0.5}$ mm, and $D_{H_2} = 2.46 \exp(-12700/RT) cm^2$ s^{-1}. The deuterium isotope effect on diffusion was small but the permeation rate fell by a factor of 1.25. It was also found that hydrogen dissolves exothermically in maraging steel. (P.C.H.)

25560 (CEA-R-2819) DEFORMATION PAR TRACTION DE L'URANIUM MONO- ET POLYCRISTALLIN ENTRE 20 ET -196 DEG C [Theses]. (Tensile Deformations in Mono- and Polycrystalline Uranium Between 20 and -196 Deg C [Thesis]). Lemogne, Andre (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 1966. 78p. Dep. mn.

Submitted to Paris Univ. (France). Faculte des Sciences.

Tensile stress tests were carried out at low temperatures (between 20 and −196°C) on monocrystalline and polycrystalline uranium of various purities. The mechanical properties of the monocrystals were related, at all temperatures, to plastic flow mechanisms. Below −100°C brittle fracture occurs on the planes making up the twins. A detailed study of the plastic behavior at −196°C made it possible to show that all the twin planes except {176} were liable to become privileged planes for brittle fracture. The mechanical properties of the polycrystals, the breaking stress, and elongation at breaking point, decreased as the temperature decreased from 20 to −196°C. It was verified that Petch's law is approximately applicable to the plastic flow and rupture stresses; a study was also made of the influence of temperature and purity on the constants occurring in this equation. Finally, experiments at −196°C on the deformation up to breaking point of polycrystalline samples cold-worked at 20°C showed the importance of the role played by intergranular cracks in the plastic behavior of uranium. (auth)

25561 (CEA-R-2857) CONTRIBUTION A L'ETUDE DU SYSTEME URANIUM–CARBONE–OXYGENE [THESES]. (Contribution to the Study of the System Uranium–Carbon–Oxygen [Thesis]). Morlevat, Jean-Pierre (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). 1966. 59p. Dep. mn.

Submitted to Grenoble Univ., France.

The region U−UC−UO_2 of the U−C−O diagram was investigated by the saturation method. This system is of the ternary eutectic type, the eutectic point lying close to pure uranium. The UO_2–UC plane can be considered as pseudobinary; it involves a eutectic UO_2–U (C,O) melting at about 2250°C. The oxicarbides U (C,O) precipitated from the melt can be considered as stoichiometric (C + O/U = 1), with a formula close to $UC_{0.65}O_{0.35}$ for deposition temperatures below 2200°C. (auth)

25562 (EIMAC-TR-66-2) INVESTIGATION OF SOLUBILITY AND DIFFUSION OF OXYGEN IN REFRACTORY METALS. First Quarterly Report, July 1, 1965–September 30, 1965. Pape, R.; Reed, L. (EIMAC, San Carlos, Calif.). Oct. 1965. Contract NAS3-7626. 28p. (NASA-CR-54647).

Electric resistivity measurements will be used to determine the solubility limits and diffusion constants of oxygen in Ta, Ta−10W, alloy T222, Nb, Nb−1Zr, and alloy FS-85. An oxygen solubility determination apparatus was designed and constructed. This consists of an electronic feedback controlled 1000°C vacuum furnace with an oxygen feed system and means for precise measurement of electric resistivity and temperature of the sample. A literature survey also showed that data for oxygen solubility in Ta and Nb is conflicting and of limited accuracy. (P.C.H.)

25563 (EURAEC-1350) ON THE THEORY OF NOTCH-BRITTLENESS IN STEELS OCCURRING DURING TIME-TO-RUPTURE TESTS. Siegfried, W. (Battelle Memorial Inst., Geneva (Switzerland)). Apr. 26, 1965. Contract 100-62-12-RDS. 78p. (EUR-2325.e; CONF-650607-2). Dep. mn. CFSTI $3.00 cy, $0.75 mn.

Work Performed under United States–Euratom Joint Research and Development Program.

From American Society of Mechanical Engineers, Berkeley.

The present experimental results are not sufficient to allow an exhaustive explanation of the embrittlement mechanism. The difference between the time-to-rupture curves for unnotched and notched bars can primarily be explained by the interaction of three effects: Relaxation of the stress peak with time. Formation and propagation of fissures in the material. Inhibition of plastic deformation owing to the formation of a tridimensional state of stress. (auth)

25564 (INR-643/XIV/PB) TWORZENIE I WZROST FAZ MIEDZYMETALICZNYCH W UKLADZIE Cu–Zn. (The Initial Formation and Growth of Intermetallic Phases in Cu–Zn System). Matyja, H.; Gabrycki, St. (Institute of Nuclear Research, Warsaw (Poland)). 1965. 18p. Dep.

The growth rate of single intermetallic α, β, and ϵ phases of the Cu−Zn system was studied, and the parabolic growth rate law was observed. Activation energies for the growth of single intermetallic phases were calculated. (auth)

25565 (INR-666/XIV/PS) OTRZMYWANIE I WLASNOSCI SPIEKANEGO URANU. (Production and Properties of Sintered Uranium). Hofman, A. (Institute of Nuclear Research, Warsaw (Poland)). Dec. 1965. 16p. Dep.

Uranium powder was obtained by decomposing uranium hydride, UH_3. Properties of the powder were investigated, and the density of sintered uranium powder dependence on pressure and sintering temperature was defined. The metallographic investigation of sintered uranium powder is described. (auth)

25566 (KAPL-3120) THE STRESS-RELAXATION BEHAVIOR OF 85-15 HAFNIUM BETWEEN 700 AND 1700 DEG F. Lovejoy, P. T.; Baldwin, E. E. (Knolls Atomic Power Lab., Schenectady, N. Y.). Nov. 1965. Contract W-31-109-eng-52. 27p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

The stress-relaxation properties of Hf were investigated between 700 to 1700°F in the longitudinal and transverse orientations. The transverse orientation is limiting, retaining a higher stress than the longitudinal orientation. A conclusion reached in a previous investigation—that 3 hr at 1200°F reduces the maximum residual stress below 5000 psi—was substantiated. An activation energy for stress-relaxation of 74,000 cal/mole in the longitudinal direction was determined. The activation energy in the transverse direction is higher. No characteristic value was determined in the transverse orientation. Incomplete stress-relief annealing of plastically deformed Hf did not result in measurable distortions. Stress-relief annealing of typical Zircaloy welds show that electron-beam welds distort less than do TIG welds, and TIG butt welds distort less than do TIG vee welds. (auth)

25567 (MSAR-66-71) EFFECT OF HIGH TEMPERATURE SODIUM ON AUSTENITIC AND FERRITIC STEELS. MECHANICAL PROPERTIES OF MATERIALS. Quarterly Progress Report, January–March 1966. (MSA Research Corp., Evans City, Pa.). Apr. 25, 1966. Contract AT(11-1)-765. 29p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

The results of studies on effects of sodium on austenitic and ferritic stainless steel at high temperature, cold trap analyses, and testing of LVDT's (Linear Variable Differential Transformers) for extensometer development are reported. Creep-rupture specimens in sodium environment exhibited a change in fracture made between short (<400 hr) and long (>1000 hr) time failures. Helium fatigue specimens showed a different type of corrosion product than was found in stainless steel 316 tests. The liquid metal extensometer system is illustrated. The most expedient method found for cold trap analyses was to drive sampling tubes into the contents. The design of the sampling tube is illustrated. (P.C.H.)

25568 (N-65-33505) EFFECT OF NUCLEATION OF SURFACE SLIP ON FLOW AND FRACTURE OF BERYLLIUM. Final Report. Lawley, A.; Breedis, J. F.; Snowden, K. V. (Franklin Inst., Philadelphia, Pa.). July 1965. Contract NASr-145. 113p. (NASA-CR-64849; F-B2028-1). CFSTI $4.00 cy, $0.75 mn.

Transmission electron microscope studies were made of the dislocation arrangements in zone-refined Pechiney beryllium oriented for basal or prism slip following fatigue at room temperature. Fatigue modes include reverse bending at 1800 cpm and low frequency (~2 cpm) uniaxial tension or compression cycling. The surface slip structure in bend fatigue was examined optically and also by using high resolution silicon monoxide replicas. A persistent slip structure developed to a depth ~6μ in both basal and prism slip orientations and bend fatigue. The persistent markings corresponded to closely spaced depressions or pits on the crystal surface and were parallel to (0001) for basal slip, or (0001) and ($0\bar{1}10$) prism slip. After prolonged examination in the electron microscope, recovery of the bend fatigue substructure occurred with a significant lowering of the dislocation density. (auth)

25569 (N-65-35213) STRAIN-AGING EFFECTS IN TUNGSTEN DUE TO CARBON. Stephens, Joseph R.; Form, Willy G. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). 1964. 36p. (NASA-TM-X-52000). CFSTI $2.00 cy, $0.50 mn.

The strain-aging characteristics of tungsten containing 8 and 40 ppM carbon were determined. Completely recrystallized tensile specimens were prestrained various amounts at 700°F and were aged at 1200, 1500, and 1800°F for times up to 4 hrs. The results show that dislocation locking by solute atoms was weak for the lower carbon level as evidenced by the lack of a yield drop in either the prestrained or aged condition. Specimens containing 40 ppM carbon exhibited a yield drop during the prestrain test. Aging for 120 min at 1200°F did not result in a return of the yield drop. The strain-aging parameter, which reflects a summary effect involving recovery, strain aging, and precipitation hardening, was negative for short aging times but increased to a positive value after aging for longer times. Aging at 1500 and 1800°F resulted in a return of the yield drop, and the strain-aging parameter was positive for all aging times. An explanation of these phenomena is proposed in terms of recent theories. (STAR)

25570 (N-65-35957) ELEVATED-TEMPERATURE TENSILE PROPERTIES OF ALLOYED TUNGSTEN FIBER COMPOSITES. Petrasek, Donald W. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Oct. 1965. 31p. (NASA-TN-D-3073). CFSTI $2.00 cy, $0.50 mn.

The effects of selected alloying elements on the elevated-temperature tensile properties of tungsten-fiber-reinforced composites were studied. Composites were made of copper, copper-2% chromium and copper-10% nickel reinforced with various volume percents of uniaxially oriented tungsten fibers. The composites were tested in tension at temperatures up to 1800°F. A comparison of the elevated-temperature tensile properties of tungsten fiber-copper alloy composites, representing soluble systems, was made with tungsten fiber-copper composites, representing a mutually insoluble system. The effects of alloying on the elevated-temperature tensile properties of tungsten-fiber-reinforced composites were also studied. A linear relation existed at elevated temperatures between tensile strength and volume percent fiber content for all the systems investigated. The copper alloy composites were weaker in tension at high volume percent fiber contents than copper composites in which alloying with the fiber did not occur. The tensile strength of the alloyed tungsten fiber decreased with increasing penetration of the alloying element into the tungsten fiber. (STAR)

25571 (N-66-16152) KINETICS OF GRAPHITIZATION. I. THE HIGH-TEMPERATURE STRUCTURAL TRANSFORMATION IN PYROLYTIC CARBONS. Fischbach, D. B. (Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena). Feb. 1, 1966. Contract NAS7-100. 40p. (NASA-CR-69917; JPL-TR-32-532). CFSTI $2.00 cy, $0.50 mn.

Under heat treatment at high temperatures, pyrolytic carbons undergo an extensive structural transformation. Layer stacking order, crystallite size, and perferred orientation increase. The kinetics of this transformation was investigated for several pyrolytic carbons in the temperature range 2400–3000°C. The transformation was found to be thermally activated, with an effective activation energy of about 260 kcal/mole. The fundamental graphitization process appeared to be the same for all of the carbons studied, but there were differences in their detailed kinetic behavior associated with differences in as-deposited microstructure. Variations in both the rate and mode of transformation can be understood in terms of the dependence of the graphitization process on apparent crystallite layer diameter. A simple model of the graphitization process consistent with these observations is discussed. The significance of these observations for engineering applications is considered briefly. (auth)

25572 (NASA-CR-67221) [RESEARCH IN MATERIALS, PLASMA, AND ELECTROCHEMICAL ENGINEERING]. Status Report. (Pennsylvania Univ., Philadelphia. Inst. for Direct Energy Conversion). July 1, 1965. 41p. (INDEC-SR-6). CFSTI $3.00 cy, $0.75 mn.

Three separate abstracts were prepared for the included sections under plasma engineering. Separate sections are included on the following transient measurement of thermal diffusivity of refractory materials at high temperature, partial molar properties of Mg base binary thermal energy storage systems, volume change on fusion for chlorides and fluorides, and transient concentration polarization in natural convection electrolysis. (M.O.W.)

For abstracts of individual sections see: 25767, 26251, and 26252.

25573 (RFP-679) A DENSITY STUDY OF BERYLLIUM. Friebel, V. R.; Campbell, G. A. (Rocky Flats Div., Dow Chemical Co., Golden, Colo.). Jan. 21, 1966. Contract AT(29-1)-1106. 7p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Densities were determined for beryllium in the vacuum-cast and wrought vacuum-cast conditions produced as part of the beryllium development program. The average densities of the Rocky Flats as-cast and wrought beryllium were approximately the same as that of commercial powder-pressed beryllium but varied over a smaller range. The density was more uniform in Rocky Flats as-cast ingots and wrought sheets than in commercial powder-pressed material. (auth)

25574 (SC-DC-66-1509) THE EFFECT OF POROSITY AND GRAIN SIZE ON THE PULSE ELECTRICAL STRENGTH OF MAGNESIUM OXIDE. Beauchamp, E. K. (Sandia Corp., Albuquerque, N. Mex.). Apr. 1966. Contract AT(29-1)-789. 27p. (CONF-660505-3). Dep. mn. CFSTI $2.00 cy, $0.50 mn.

From American Ceramic Society Meeting, Washington, D. C.

Pulse electrical strength measurements were made on hot pressed magnesium oxide containing 0.3% lithium fluoride. A simple recessed-electrode configuration eliminated corona effects. Strengths as high as 5900 volts/mil were obtained on samples of 99.9% theoretical density and 1 to 3 micron grain size. A monotonic decrease in strength occurred with an increase of either porosity or grain size. (auth)

25575 (WANL-PR-(Q)-008) DEVELOPMENT OF DISPERSION-STRENGTHENED TANTALUM-BASE ALLOY. Quarterly Progress Report No. 7, May 20, 1965–August 20, 1965. Buckman, R. W. Jr.; Goodspeed, R. C. (Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.). Contract NAS 3-2542. 56p. (NASA-CR-54892).

Development of dispersion-strengthened Ta base alloys for use in advanced space power systems continued with the processing of the upset forged ingot of T-333 (Ta–8W–1Re–0.7Hf–0.025C) to 0.040 in. sheet. Evaluation of this material was initiated. The seventh and final optimized composition was melted and processed. Evaluation of these alloys was also completed. Phase identification and morphology studies were continued using optical and electron microscopy and x-ray and electron diffraction techniques. (auth)

25576 (JPRS-34566) RHENIUM ALLOYS. Savitskii, E. M.; Tylkina, M. A.; Povarova, K. B. Translation of pp 26-31; 168-235; 255-331 from Splavy Reniya, Nauka Publishing House, Moscow, 1965. 217p. (TT-66-31006). CFSTI $6.00 cy, $1.25 mn.

Selected chapters of the Russian-language book on Re and Re alloys were translated. The translated chapters cover the following topics: consolidation, preparation and treatment of the alloys, mechanical properties, weldability, elastic properties, heat expansion, uses in electronics and electrical engineering, uses in thermocouples, uses as electric contacts, chemical heat treatment, coatings, corrosion resistance, and catalytic properties. (W.L.G.)

25577 (LA-tr-66-22) WIEDEMANN-FRANZ-LORENTZ LAW AND ITS APPLICATION IN THE HIGH-TEMPERATURE FIELD. Evangelisti, Roberto. Translated for Los Alamos Scientific Lab., Univ. of California, N. Mex., from Riv. Ing., 14: No. 8, 761-71(1965). 20p. Dep. mn. JCL $1.60 fs, $0.80 mf.

Utilizing the Wiedemann-Franz-Lorentz law, analytic expressions were derived for the electric and thermal conductivities of metals in the temperature range of 100 to 1000°C. (M.O.W.)

25578 (N-65-35787) CONTACT INTERACTION OF METAL-LIKE CARBIDES, NITRIDES AND BORIDES WITH REFRACTORY METALS AT HIGH TEMPERATURES. Samsonov, G. V.; Strashinskaya, L. V.; Shiller, E. A. Translated from Izv. Akad. Nauk SSSR, Otd. Tekh. Nauk Met. i Topliyo, No. 5, 1962. 26p. (NASA-TT-F-9713). CFSTI $2.00 cy, $0.50 mn.

Detailed results are presented of a study of the interaction of powdered carbides (TiC, ZrC, HfC, NbC, TaC, Mo_2C, WC), nitrides (TiN, ZrN), and borides (TiB_2, ZrB_2, TaB_2) with solid Nb, Ta, Mo, and W held in contact at 900 to 2200°C for 2 or 5 hr in a vacuum. Data obtained by microscopic examination and microhardness measurements show that up to 1100°C none of the compounds tested reacts with refractory metals. (STAR)

25579 YTTERBIUM–SELENIUM DIAGRAM. CRYSTALLOGRAPHIC STUDY OF THE REGION BETWEEN YbSe AND Yb_3Se_4. Guittard, Micheline; Flahaut, Jean; Domange, Louis (Faculte de Pharmacie, Paris). Compt. Rend., Ser. C, 262: 1002-5(Mar. 21, 1966). (In French).

The compound, Yb_3Se_4, has two crystalline varieties. One is orthorhombic and stable at low temperatures and the other is rhombohedral and stable at high temperatures. The passage from one to the other is reversible and takes place at 1200 and 1250°C. A continuous solid solution exists between YbSe and the rhombohedral form Yb_3Se_4 at high temperature, with successive appearances of a cubic superstructure and then of a rhombohedral deformation, which is accentuated up to the composition YbSe. (tr-auth)

25580 ELASTIC CHARACTERISTICS OF NIOBIUM–ALUMINUM ALLOYS. Nedyukha, I. M.; Chernyi, V. G. (Inst. of Problems in Casting, Academy of Sciences, Ukrainian SSR). Fiz. Metal. Metalloved., 20: 787-8(Nov. 1965). (In Russian).

Results of measurements are shown for the effect of Al content from 0.9 to 7.3% by weight on characteristics of polycrystalline niobium — the normal elasticity modulus, shear modulus, modulus of volume compression, Poisson coefficient, characteristic temperature, and mean square deviation of the atoms from equilibrium position in the crystal lattice. (M.J.T.)

25581 RECRYSTALLIZATION DIAGRAM FOR RHENIUM OF HIGH PURITY. Savitskii, E. M.; Chuprikov, G. E. (Baikov Metallurgical Inst., Academy of Sciences SSSR). Izv. Vyssh. Ucheb. Zaved., Tsvetn. Met., No. 1, 112-15(1966). (In Russian).

The recrystallization diagram of high-purity rhenium (produced by octuple vacuum zone refining) deformed by cold-rolling was constructed by the method of microstructure and x-ray analysis with hardness measurement. The temperature for the onset of recrystallization of high-purity rhenium is in the interval from 1000 to 1500°C and for cast rhenium from 1200 to 1750°C. The critical degree of deformation is 3 to 5%. (tr-auth)

25582 THE ASSESSMENT OF PLUTONIUM AND FISSION PRODUCT DISTRIBUTION IN MAGNOX CANS FROM IRRADIATED FUEL ELEMENTS. Hines, G. F.; Reed, D. (Central Electricity Generating Board, Berkeley, Eng.). J. Appl. Chem. (London), 16: 90-3(Mar. 1966).

Mechanical sectioning and autoradiography were used to establish the concentration profiles of fission products and plutonium in irradiated Magnox cans. The results obtained by the two methods were in good agreement and enabled an estimate to be made of 2 to 4×10^{11} cm^2sec^{-1} for the diffusion coefficient of plutonium in Magnox ZR55 at 400°C. Progressive chemical dissolution methods are shown to be unsatisfactory for the determination of concentration profiles. (auth)

25583 ELECTRICAL RESISTIVITY OF EQUIATOMIC RARE EARTH–NOBLE METAL COMPOUNDS. Chao, Chang-Chih (California Inst. of Tech., Pasadena). J. Appl. Phys., 37: 2081-4(Apr. 1966).

The electrical resistivity of twenty CsCl type intermediate phases of Gd, Tb, Dy, Ho, Er, and Tm with Cu, Ag, and Au and of Y and Nd with Ag were measured from 4.2°K to about 250°K. All of the resistivity-temperature curves, except that of YAg, show anomalies at temperatures that are in good agreement with the available antiferromagnetic-paramagnetic transition temperatures obtained by either neutron diffraction studies or magnetic susceptibility measurements. The spin disordering part of the resistivity of the CsCl phases were deduced and any attempt to apply the theory of de Gennes and Friedel, which was used by Rocher for pure rare-earth elements, was not successful. (auth)

25584 PREFERRED ORIENTATION PARAMETERS FOR PYROLYTIC CARBONS. Fischbach, D. B. (California Inst. of Tech., Pasadena). Contract NAS7-100. J. Appl. Phys., 37: 2202-3(Apr. 1966).

It is demonstrated that a variety of analysis techniques and characteristics parameters used for measurement of preferred orientation in pyrolytic carbon are equivalent, and that a simple relation exists between them. (L.B.S.)

25585 CHEMISORPTION OF ELECTRONEGATIVE GASES ON REFRACTORY METALS. Shaw, Marion L.; Carleton, N. P. (Harvard Univ., Cambridge, Mass.). J. Chem. Phys., 44: 3387-92(May 1, 1966).

A study was made of some aspects of the chemisorption of diatomic gases on metal surface for temperatures of 1800°–2200°K and pressures of $4.0–6.0 \times 10^{-6}$ torr. The

systems studied were chlorine and carbon on tungsten where the carbon was present as a contaminant, and chlorine and hydrogen chloride on hafnium. The flux of atomic negative ions formed from the dissociated gases on the surfaces were observed as functions of temperature concurrently with the thermionic electron flux from the same surfaces. From these data work functions and sticking probabilities were calculated, using the Saha-Langmuir equation. For tungsten, it was found that the sticking probability of chlorine was about 4×10^{-3} and tended to decrease with increase in temperature. The increment in work function was about the order of the experimental uncertainty, 0.50 ev. For hafnium the sticking probability was about 1×10^{-2} for both chlorine and hydrogen chloride and tended to increase with temperature, especially in the presence of oxygen at a partial pressure of 5×10^{-6} torr. This temperature dependence was interpreted as an indication of a contaminated surface. The work function was not noticeably changed by chlorine or hydrogen chloride. Introduction of oxygen into the system caused the work function to increase noticeably. (auth)

25586 HIGH TEMPERATURE PHASE EQUILIBRIA IN THE SYSTEMS Sm_2O_3–WO_3 AND Sm_2O_3–W–WO_3. Chang, L. L. Y.; Scroger, M. G.; Phillips, B. (Tem-Pres Research Inc., State College, Pa.). J. Inorg. Nucl. Chem., 28: 1179-84(May 1966).

Using sealed-capsule techniques, the system Sm–W–O was studied at high temperatures with emphasis on the formation and stability of ternary phases. The equilibrium relations in the region Sm_2O_3–W–WO_3 at 1700°C and along the join Sm_2O_3–WO_3 were determined in detail. Three ternary phases were found to be stable at high temperatures. They are $3Sm_2O_3 \cdot WO_3$, and $7Sm_2O_3 \cdot 4WO_3$ with melting points of 2240 and 2190°C, respectively, and $Sm_2O_3 \cdot WO_3$, which melts incongruently at 1690°C. Two low-temperature phases, $Sm_2O_3 \cdot 2WO_3$ and $Sm_2O_3 \cdot 3WO_3$, were also formed in the system, and melt at 1245 and 1155°C, respectively. The reaction between the platinum capsule and metallic samarium, which destroyed the sealed system, prevented the collection of reliable phase data for the Sm–Sm_2O_3–W compositional range of the system. Experiments on alloying tungsten and samarium in hydrogen also failed to produce significant data for the W–Sm join due to the loss of samarium at high temperatures. No attempt was made to determine the actual pressure and the partial pressure of oxygen necessary to maintain the condensed phase equilibrium relations shown. Generalities governed by thermodynamics and the phase rule are stated. (auth)

25587 EFFECTS OF MOLYBDENUM ON THE PROPERTIES OF Cr15–Ni85 ALLOY. Kontorovich, I. E.; Voshedchenko, B. M.; Buntushkin, V. P. (Moscow Evening Metallurgical Inst.). Metalloved. Term. Obrabotka Metal., No. 1, 19-21(Jan. 1966). (In Russian).

As the concentration of molybdenum in the alloy increased, the strength of the solid solution after quenching increased. During prolonged aging (20 hrs at 680°C) the hardness increased, with simultaneous decreases in microhardness, which was produced by separation of the intermetallides and nickel and molybdenum. For aging periods of 4 hrs, the lattice phase and the specific electric resistivity did not change, which indicated the presence of modifications in the alloying of the solid solution. The modifications to hardness after short-term aging appeared to be a result of intergranular processes, distribution of the alloying elements and possibly modifications of the density of the dislocations. (tr-auth)

25588 NICKEL–CHROMIUM ALLOYS WITH NIOBIUM. Sbeshnikova, G. A. Metalloved. Term. Obrabotka Metal., No. 1, 29-34(Jan. 1966). (In Russian).

Nickel–chromium alloys with 20% Cr and 6 to 9.6% Nb have a capacity for aging. At comparatively low temperatures of aging from solid solutions, the finely dispersed sintered phase, Ni_3Nb, appeared and this was converted into the equilibrium lamellar phase with a rhombic lattice. The transition of the finely dispersed surface phase into the lamellar phase did not cause a decrease in the hardness of the 7.2% Nb alloy. In the alloy with 6% Nb the hardness increased (during prolonged aging). The maximum heat resistance (at 700 and 750°C and stresses of 30 and 20 kg/mm^2, respectively) of the alloy system Ni + 20% Cr + Nb occurred at 7.2% Nb. (tr-auth)

25589 THERMAL STRESSES IN A FINITE SOLID CYLINDER DUE TO AN AXISYMMETRIC TEMPERATURE FIELD AT THE END SURFACE. Iyengar, K. T. Sundara Raja; Chandrashekhara, K. (Indian Inst. of Science, Bangalore). Nucl. Eng. Design, 3: 21-31(Jan. 1966).

A three-dimensional rigorous solution for determining thermal stresses in a finite solid cylinder due to a steady-state axisymmetric temperature field over one of its end surfaces is given. Numerical results for a solid cylinder having a length-to-diameter ratio equal to one and subjected to a symmetric temperature variation over half the radius of the cylinder at the end surfaces are included. These results were compared with the results of the approximate solution given by W. Nowacki. (auth)

25590 STEADY-STATE STRESSES IN CONCRETE STRUCTURES SUBJECTED TO SUSTAINED TEMPERATURES AND LOADS. PART I. CASES OF UNIAXIAL STRESS. England, G. L. (London Univ.). Nucl. Eng. Design, 3: 54-65(Jan. 1966).

The influence of creep and temperature on the behavior of concrete structures is discussed with restriction to cases of uniaxial stress. Under the combined effects of nonuniform temperature and stress it is shown that redistribution takes place and that eventually stresses may reach stationary values if the temperature and load conditions are sustained. These steady-state stresses together with the initial values form upper and lower bounds. Theorems are presented that enable the steady-state stresses, moments and forces to be calculated directly and without reference to the elastic or thermal expansion properties of concrete, for structures in which member sections remain plane. A worked example is given and some experimental support to the theory is provided from data relating to two-span continuous prestressed concrete beams subjected to temperature crossfalls. Application of the theory to three-dimensional stressing is mentioned and it is concluded that the ability to calculate steady-state stresses is of importance in the design of heated concrete structures. (auth)

25591 CALCULATION OF ORTHOGONAL ELASTIC REINFORCED MAXWELL SHELLS WITH SMALL REINFORCING MEMBERS (FOR EXAMPLE, REINFORCED CONCRETE SHELLS). PART I. Schoop, Heinrich (Technische Univ., Berlin). Nucl. Eng. Design, 3: 138-62(Jan. 1966). (In German).

The constitutive equations for shallow shells of viscoelastic (Maxwell) material with elastic reinforcement are derived. With respect to reinforced concrete shells, shrinkage is considered. (Constitutive equations mean relations between stress resultants, as membrane forces, bending and twisting moments, and strains or distortions of the shell middle surface, and further, formulas for the determination of the stress resultants related to the elastic and to the viscoelastic part of the section, respectively.) Concerning strain geometry, the usual assumptions of the theory of elastic shells are made. The reinforcement shall be orthogonal, but may be unsymmetrical to the middle surface and locally variable. Influences of transverse contraction are not considered. The derivations are based on the tri-dimensional constitutive equations for viscoelastic media of the type of reinforced concrete as established previously. This characteristic behavior is also expressed in the constitutive shell equations given. Using the derived constitutive equations there are given the displacement equations of the orthotropic Maxwell shell. Exact solutions can only be found for some simple cases (i.e., for a simply supported rectangular plate). Therefore these equations are transformed in a way that perturbation calculation can be applied. Thus the solution is reduced to the solution of the corresponding elastic problem and to the finding of particular integrals. This method of analysis

of orthotropic Maxwell shells is applied to the following examples: circular cylindrical shell, rectangular plate, and circular disk with locally variable reinforcement. It is found that partly the stress resultants are considerably different (more than 20%) from those of an elastic isotropic shell and after creeping even different from those of the corresponding orthotropic elastic shell. It may even occur, that the stress resultants in the visco-elastic component of the material act against the reinforcement stress resultants. (auth)

25592 THERMAL CONDUCTIVITY OF PYROLYTIC GRAPHITE. Taylor, R. (United Kingdom Atomic Energy Authority, Culcheth, Eng.). Phil. Mag. (8), 13: 157-66(Jan. 1966). (TRG-Report-935(Rev. 1)).

The thermal conductivities of three specimens of well-oriented, annealed pyrolytic graphite were measured over the temperature range 100 to 900°K. The conductivity parallel to the deposition plane is analyzed in terms of mean free paths using the semicontinuum model of Komatsu and Nagamiya. An expression is derived for the phonon mean free path due to Umklapp scattering. A temperature independent phonon mean free path results from boundary scattering. The conductivity perpendicular to the deposition plane is fitted to the Leibfried-Schlomann equation. (auth)

25593 EMBRITTLEMENT OF MOLYBDENUM AT AVERAGE AND HIGH TEMPERATURES. Pink, E. (Metallwerk Plansee AG, Reutte/Tyrol, Austria). Planseeber. Pulvermet., 14: 15-22(Apr. 1966). (In German).

Molybdenum embrittlement occurs during tensile tests at elevated temperatures. At 800°C it is likely to be initiated by interstitial impurity interactions. Above 1300°C embrittlement is caused by increasing weakness at the grain boundaries and subsequent formation of voids. (auth)

25594 RHENIUM–CHROMIUM–CARBON SYSTEM. Gorshkova, L. V.; Fedorov, T. F.; Kuzma, Y. B. (Lvov State Univ.). Porosh. Met., Akad. Nauk Ukr. SSR, No. 3, 75-7(Mar. 1966). (In Russian).

The Re–Cr–C system was investigated by means of x-ray and microstructure analysis. The phase equilibria were established for cast alloys at 1300°C. The compound $Cr_{23}C_6$ dissolved approximately 20 at. % Re, and this solid solution had an ordering arrangement of the atoms. (auth)

25595 STRUCTURE OF α-UO_3. Loopstra, B. O.; Cordfunke, E. H. P. (Reactor Centrum Nederland, Petten, Netherlands). Rec. Trav. Chim., 85: 135-42(Feb. 1966).

From the neutron diffraction pattern of α-UO_3 it was found that the generally accepted hexagonal structure is incorrect. Both chemical and structural arguments indicated that α-UO_3 is an imperfectly crystalline form of the orthorhombic modification generally called $UO_{2.9}$. This substance has an unknown structure, which is shown to be disordered. (auth)

25596 FIELD-EMISSION MICROSCOPY OF Ni–Be ALLOYS. Komar, A. P.; Syutkin, N. N. (Ioffe Inst. of Physics and Tech., Leningrad). Soviet Phys.-Solid State (Engl. Transl.), 7: 2670-6(May 1966).

Translated from Fiz. Tverd. Tela, 7: 3310-19(Nov. 1965).

Pictures of a quenched and tempered Ni–Be alloy, held at various temperatures, were obtained with an electron field-emission microscope. A study of all the pictures obtained supplied data on the topography of individual electron emissions, and conclusions were drawn regarding the decomposition geometry and kinetics of the alloy, as well as about migration and coagulation of the phase which separated out. (auth)

25597 A STANDARD REFERENCE MATERIAL FOR MOESSBAUER SPECTROMETRY OF IRON AND ITS COMPOUNDS. Spijkerman, J. J.; Ruegg, F. C.; DeVoe, J. R. (National Bureau of Standards, Washington, D. C.). pp 254-9 of STI-DOC-10/50.

The preparation and properties of single crystals of sodium nitroprusside as a standard reference material for Mössbauer studies are briefly discussed. (D.C.W.)

25598 EVOLUTION OF PORE AND GRAIN SIZE IN HYDROGEN-SINTERED URANIUM DIOXIDE. Amato, I.; Colombo, R. L.; Protti, A. M. (FIAT, Turin). pp 189-98 of Symposium sur la Metallurgie des Poudres, Paris, Juin 1964. Saint-Germain-en-Laye, France, Editions Metaux, [1965].

Current theories on pore skrinkage and grain growth during sintering of ceramic bodies are reviewed. Work done up to date on uranium oxide is critically examined. Experiments were carried out on sintered uranium dioxide bodies of low and high fired densities, both porosimetric and micrographic studies being done. It was found that the porosity is made up of two fractions, one coarse and one fine. The overall coarse porosity increases with increasing density and the average coarse pore diameter is also likely to increase. The fine porosity volume has a quasi-log-normal distribution and rapidly drops down with increasing density, while the average fine pore diameter shows a moderate decrease. Maximum pore size for extremely dense specimens shifts to higher values with longer heat treatment. Mechanisms envisaged by theoreticians to explain the interactions of pore, grain boundaries, strains and the like were found to be effective in individual instances. (auth)

25599 ON THE PROBLEM OF VAPORIZATION OF SECONDARY METALS BY VACUUM TREATMENT OF HARD METALS. Ruediger, O.; Rottger, H. (Fried Krupp, Essen). pp 259-69 of Symposium sur la Metallurgie des Poudres, Paris, Juin 1964. Saint-Germain-en-Laye, France, Editions Metaux, [1965]. (In German).

Above 1300°C the binder evaporates from cemented carbide surfaces wetted by the binder phase. The heat of vaporization proved to be 94 kcal/mole for pure cobalt as well as for carbides with 6–40 wt % cobalt. The evaporation rate was the same from a cobalt melt with 46 wt % tungsten carbide as for carbides of various cobalt contents, providing the geometrical arrangement of the evaporation chamber was identical. The evaporation rate of cobalt was reduced by dissolved tungsten or tungsten carbide. For instance, a cobalt melt containing 40% tungsten has an activation coefficient of 0.6. The evaporation of the binder did not cause porosity in the cemented carbides studied; actually the metal carbide densifies during the evaporation of the cobalt. Increased grain growth of the carbide crystals was found in the surface layer of samples treated at 1500°C and 10^{-4} Torr for 4 hours. A coherent carbide layer was formed on the surface of tungsten carbide-cobalt alloys during evaporation. This layer became increasingly impermeable to cobalt as evaporation proceeded. A surface layer of coarse-grained carbide was also formed on cemented carbides of hard metals containing titanium carbide, but it was porous and therefore permeable to the binder phase reaching the surface by a wetting process. As previously reported, the cobalt in such alloys can evaporate to leave a very small residue. (auth)

25600 RADIOCRYSTALLOGRAPHIC STUDY OF STRESSES IN SINTERED WC–Co ALLOYS AND THEIR DEVELOPMENT AS A FUNCTION OF TEMPERATURE. Bernard, R.; Riviere, R.; Mai-Xuan (Institut National des Sciences Appliquees, Lyon). pp 271-8 of Symposium sur la Metallurgie des Poudres, Paris, Juin 1964. Saint-Germain-en-Laye, France, Editions Metaux, [1965]. (In French).

The existence of stresses in sintered alloys of tungsten carbide and cobalt is a natural consequence of the difference between the coefficients of expansion of the two constituents (WC: $\alpha = 54.10^{-7}$; Co: $\alpha = 124.10^{-7}$). The presence of these stresses is apparent in considerable variations in the mechanical properties, particularly in the bending strength. A systematic study of these stresses was made by means of x-ray diffraction. It was found that the high strains disappear at about 300 of 400°C, at the same time as the asymmetry that is attributed to them. This is in good agreement with the fact that the brittleness of the alloys was found to be reduced below 300°C (resistance to rupture due to thermal shock). The compressive

and tensile stresses responsible for broadening of the x-ray diffraction beam seem, on the other hand, to disappear only at about 600 or 700°C, which may be regarded as the forming temperature, i.e. a temperature above which the stresses developed as a result of cooling in the solid phase are compensated by plastic deformation. Finally, the study of an alloy of high cobalt content showed that a state of stress persists beyond 700°C, which confirms the existence of stresses set up between 1400 and 1290°C. (auth)

25601 INFLUENCE OF THE MATRIX ON THE HARDNESS OF TUNGSTEN CARBIDE CRYSTALS. Knotek, O.; Mariacher, H. (Deutsche Edelstahlwerke Titanit Fabrik, Krefeld, Ger.). pp 363-8 of Symposium sur la Metallurgie des Poudres, Paris, Juin 1964. Saint-Germain-en-Laye, France, Editions Metaux, [1965]. (In German).

Measurements on WC crystals, prepared by arc-melting hard-metal electrodes, gave microhardness values of only 1200–1400 kg/mm^2. X-ray back-reflection photographs showed Fe, WC, M_6C; Fe_7W_6 or Fe_3W_2 phases and WO_3, but not W_2C. An arc-melted Co–Cr–W–C matrix alloy had micro hardness values of 1800–1850 kg/mm^2. Both specimens were studied by microprobe analysis. The first contained no foreign elements in the WC, apart from Fe, but in the second there was, in addition to a little Co and Fe, a distinct Cr diffusion in WC. The low microhardness in the former case was attributed to stresses and lattice defects, the somewhat higher micro hardness in the latter case was considered a result of diffused Cr. (auth)

25602 THERMAL EXPANSION OF TUNGSTEN AND TANTALUM AT 1500 TO 3000 deg C. V'yugov, P. N.; Gimenyuk, V. S. (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Teplofiz. Vysok. Temp., 3: 936-7(Nov.-Dec. 1965). (In Russian).

Tantalum and tungsten rods 2 mm in diameter and 200 to 240 mm long were heated by passing an electric current through the sample in a vacuum of $<1 \times 10^{-6}$ mm Hg std. One end of the sample was clamped by a water-cooled electric lead, and the other end was placed in a liquid-lead bath. Two additional tungsten spirals served to level out the temperature along the sample. The distance between two marks on the rod was measured by a cathetometer at room temperature and in the heated state. The temperature was measured by means of an optical pyrometer. The relative expansion was expressed empirically as follows: for tungsten, $\Delta L/L_0 = -6.6 \times 10^{-5} + 3.7 \times 10^{-6}\ T + 8.7 \times 10^{-10}\ T^2$, and for tantalum, $\Delta L/L_0 = -1 \times 10^{-4} + 6.5 \times 10^{-6}\ T + 7.45 \times 10^{-10}\ T^2$. Here L_0 is the sample length at 20°C, and T is the sample temperature in °C. The true linear expansion coefficients were found to be: for tungsten, $\alpha = (3.7 + 1.74 \times 10^{-3}\ T)\ 10^{-6}\ (°C)^{-1}$, and for tantalum, $\alpha = (6.5 + 1.49 \times 10^{-3}\ T)\ 10^{-6}\ (°C)^{-1}$. (TTT)

25603 DENSITY AND STRUCTURE OF URANIUM OXIDES IN COMPOSITION RANGE UO_3 TO U_3O_8. Strekalovskii, V. N.; Beketov, A. R.; Vlasov, V. G. Tr. Inst. Elektrokhim., Akad. Nauk SSSR, Ural. Filial, No. 6, 131-6 (1965). (In Russian).

On the basis of a comparison of the x-ray phase analysis and density measurements, the dependence of the density on the structures formed in the system UO_3–$UO_{2.67}$ (during dissociation of α- and γ-trioxide) was found. The parameters of the elementary cell of the solid solutions with hexagonal structure in the range α-UO_3 to $UO_{2.9}$ and orthorhombic structure in the range $UO_{2.2}$ to $UO_{2.67}$ were calculated. It was found that solid solutions formed in the range $UO_{2.9}$ to $UO_{2.67}$ with orthorhombic structure are defective, and that the defects are characteristics both for the oxides and for the uranium sublattices. (tr-auth)

25604 ADSORPTION OF WATER AND CARBON DIOXIDE ON BERYLLIUM OXIDE. Stuart, W. I.; Whateley, T. L. (Australian Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). Trans. Faraday Soc., 61: 2763-71(Dec. 1965).

Infrared spectrophotometry was used to investigate adsorption of water and carbon dioxide on beryllium oxide. The spectra of adsorbed carbon dioxide were related to kinetic and isotherm data. At 25°C, water is physically adsorbed, and also chemisorbed to form surface hydroxyl groups. Physically adsorbed molecules are desorbed by vacuum pumping at 25°C, but hydroxyl groups are completely removed only after heating at 550°C. Between 25 and 200°C carbon dioxide is chemisorbed to form a simple surface carbonate ion CO_3^{2-}, and a bidentate carbonate species. Above 300°C only the carbonate ion is formed. Kinetics of chemisorption can be described exactly by the Elovich equation. The intensity of an infrared absorption band at 1580 cm^{-1} increases markedly when water, deuterium oxide, or carbon dioxide is chemisorbed. These increases are thought to be related to formation of defects near the surface. A shift in frequency to 1550 cm^{-1} when water or methanol molecules are physically adsorbed is due to hydrogen bonding between these molecules and the surface hydroxyl groups. (auth)

25605 ON THE ESTABLISHMENT OF CONCENTRATION EQUILIBRIUM IN CRYSTALLIZATION OF HELIUM ISOTOPE SOLUTIONS. Bogoyavlenskii, I. V.; Bereznyak, N. G. (Inst. of Physics and Tech., Khar'kov). Ukr. Fiz. Zh., 10: 1376-7(Dec. 1965). (In Ukrainian).

Monoisotopic targets of Ti, Zr, and Hf were prepared by the thermal dissociation of the idodide compound with the use of a directed stream of molecules in a continuously evacuated chamber. Targets 1 to 7 microns thick were prepared. An x-ray structural analysis was carried out on Ti, Zr and Hf targets deposited on a molybdenum backing over a temperature interval of 950 to 1250°C. The presence and the degree of perfection of the target texture were determined. Zr showed practically no texture. The Ti and Hf targets gave the most pronounced texture at 1050 to 1100°C. The crystal size of the deposited isotope increased with the temperature of the Mo backing. (TTT)

25606 LOW-TEMPERATURE RECRYSTALLIZATION OF MICROCRYSTALS OF TUNGSTEN. Garber, R. I.; Afanas'ev, V. I.; Dranova, Zh. I.; Mikhailovskii, I. M. (Inst. of Physics and Tech., Kiev). Zh. Eksp. Teor. Fiz., 50: 520-4(Mar. 1966). (In Russian).

Tungsten deformed at nitrogen temperature was studied in an field ion microscope after being kept at room temperature. It is shown that in the deformed boundary region of the microcrystals new recrystallization centers may arise at 600–700°C. The transverse size of the stable grain is 20–60 Å at a disorientation angle of 8–10°. The dislocation structure of the boundaries is discussed. (auth)

25607 ETCHING DISLOCATIONS IN ZIRCONIUM. Mills, D.; Craig, G. B. (Univ. of Toronto). 10p. (CONF-651017–10). ORAU. Gmelin, AED-CONF-65-289-9.

From Electrochemical Society Meeting, Buffalo.

A technique was developed for revealing both grown-in and glide dislocations in zirconium. The method depends on the presence of a surface oxide film produced by prior etching and is sensitive to the orientation of the surface. Bend tests showed a satisfactory agreement between calculated and measured dislocation densities. Pits separated by 1 micron were resolved optically using this technique. (auth)

25608 A MECHANICAL PROPERTY EVALUATION OF Be–38 PERCENT Al ALLOY FROM –320 TO 800 DEG F. Fenn, R. W. Jr.; Crooks, D. D.; Watts, G. H.; Neiman, A. S. (Lockheed Missiles and Space Co., Palo Alto, Calif.). 24p. (CONF-651031–3). ORAU. Gmelin AED-CONF-65-331-3.

From American Society of Metals Meeting, Detroit.

Detailed studies were made on six heats of commercially produced Be–38 wt % Al alloy in the annealed temper to determine the level and reproducibility of the mechanical properties, microstructural features, and general metallurgical quality of the material. Young's Modulus, tensile, compressive, shear, bearing, and bend properties were determined at temperatures between –320 and 800°F. Tensile properties at 75°F were found to be unaffected by exposure at temperatures up to 800°F for times up to 1000 hr. Sheet properties were consistently isotropic, while the extrusion properties displayed some anisotropy. Reproduci-

bility of properties from heat to heat was investigated by statistical analysis; variations were found to be equal to or less than those reported for several commercial alloys in current use. The substantial decrease in strength in the 400°F temperature region, normally associated with aluminum alloys, was not observed for the Be–38% Al alloy. Over 50% of the room temperature tensile properties was retained at 800°F. (auth)

25609 TEXTURE, MICROSTRUCTURE AND MECHANICAL PROPERTY OF THIN-WALLED ZIRCALOY-2 TUBES. Okada, Takeshi; Hirano, Hiroshi; Kunimoto, Nobuo (Kobe Steel, Ltd., Japan). 26p. (CONF-651017–11). ORAU. Gmelin, AED-CONF-65-289-14.

From Electrochemical Society Meeting, Buffalo.

Microstructure and texture, such as grain and precipitation formed during deformation and heat treatment of thin-walled Zircaloy-2 tubes were studied. Various manufacturing processes result in different types of texture, microstructure, and mechanical properties. Textures of cold-reduced and cold-drawn tube were similar to those of cold-rolled sheet. Those of cold-swaged tube were assigned with the indices (0001) [10$\bar{1}$0] with (0001) rotated ±80 and ±50° out of the surface of tube about the longitudinal and the transverse directions, respectively. Grouped hydrides in various tubes were oriented in different ways. Their orientation can be explained by means of habit planes (10$\bar{1}$0) in the preferred orientation. (auth)

25610 COLUMBIUM-BASE ALLOY OF IMPROVED FABRICABILITY. Clark, Jack W. (to General Electric Co.). U. S. Patent 3,236,638. Feb. 22, 1966. Filed Nov. 1, 1963.

A Nb-base alloy having improved fabricability characteristics and as-welded ductility along with moderate strength at high temperatures is described that is suitable for use in intricate structures such as for alkali metal containment in power systems. The alloy consists of 5 to 25 wt % W, 0.5 to 3.0 wt % Zr or Hf, 0.04 to 2.0 wt % Y, 0.01 to 0.2 wt % C, 0.01 to 0.04 wt % O_2, with the balance Nb and incidental impurities. The atomic ratio of either Zr or Hf to C is from about 0.5:1 to 3.0:1. (B.L.M.)

25611 COBALT BASE ALLOYS CONTAINING MOLYBDENUM. Rausch, John J.; McAndrew, Joseph B. (to U. S. Navy). U. S. Patent 3,243,289. Mar. 29, 1966. Filed Sept. 24, 1963.

A Co–Mo alloy is described that contains 1 to 15 wt % Mo with the balance being Co to yield an alloy of Co that is strong and ductile while retaining sufficient forgeability to be usefully workable. The addition of either Si or Be improves the oxidation resistance of the base alloy; the addition of 8 wt % Al reduces the scaling rate of the base alloy; and the addition of Ta, Nb, or Al increases the yield strength and ductility of the base alloy. (B.L.M.)

25612 TANTALUM BASE ALLOY. Clark, Jack W.; Jones, Edward S. (to General Electric Co.). U. S. Patent 3,243,290. Mar. 29, 1966. Filed July 22, 1963.

Some high strength Ta base alloys, particularly precipitation- and solid-solution-hardened Ta alloys are described that have high strength in the temperature range of 2400 to 3000°F combined with good low temperature ductility. The Ta is alloyed with 8–12 wt % W, 0.01–0.5 wt % C, and 0.08–2.0 wt % Hf or Zr. The Zr:C or Hf:C ratio is between 0.2:1 and 2:1. The offset yield strength of the alloys is over 20,000 psi at 3000°F. (B.L.M.)

25613 HIGH-TEMPERATURE ALLOY. Dickinson, Clayton D.; Friedman, Sam (to General Telephone and Electronics Labs., Inc.). U. S. Patent 3,243,291. Mar. 29, 1966. Filed Oct. 29, 1963.

Tungsten base alloys that have ultimate tensile strengths in the range of 25,000 to 73,000 psi at a temperature of 1650°C and yet retain good ductility at low temperatures are prepared by alloying the W with 0.004 to 0.05 wt % C and between 0.01 and 2.0 wt % of a reactive metal selected from the group consisting of Hf, Zr, and Ti. (B.L.M.)

25614 CLAD ALLOY FUEL ELEMENTS. Lustman, B.; McGeary, R. K. (to U. S. Atomic Energy Commission). U. S. Patent 3,243,350. Mar. 29, 1966.

A fuel element suitable for use in a nuclear reactor with a minimum life of about 125 days even when its cladding contains a hole having a diameter of 0.04 inch is described. The core consists of an alloy with 75 to 99 wt % uranium and the balance of either molybdenum or niobium. The cladding layer covering the core consists of an alloy of 0.1 to 2.5 wt % tin, from 0.1 to 2 wt % of either iron, nickel, or chromium, and the balance was zirconium, with less than 0.5% of incidental impurities. The thickness of the cladding layer was 0.03 inch. (AEC)

Radiation Effects

See also CHEMISTRY — Radiation Chemistry

Refer also to abstracts 26365 and 26368.

25615 (DP–1019) IRRADIATION TESTS OF URANIUM METAL TUBES FOR D_2O-COOLED REACTORS. Nemeth, Stephen R. (comp.) (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). Feb. 1966. Contract AT(07-2)-1. 65p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

Dimensional changes in experimental uranium metal tubular fuel elements exposed in the Heavy Water Components Test Reactor (HWCTR) are described. The irradiation tests simulated conditions in a pressurized heavy-water-moderated-and-cooled power reactor. The Zircaloy-clad coextruded fuel elements were approximately 2 inches OD and up to 10 feet long. Tests were conducted at metal temperatures up to 500°C, reactor pressures up to 1200 psi, and exposures up to 6800 Mwd/te U. The uranium metal fuel tubes that contained dilute (<1000 ppM) Fe, Si, and Al additions performed better (<3% volume change) than the U–1.5 wt % Mo, the U–2 wt % Zr alloys, or the unalloyed uranium tubes (6–10% volume change). Irradiation results for Zr–9.3% enriched uranium HWCTR driver fuel tubes and Th–1.4% enriched uranium fuel tubes are also presented. The performance of both of these fuels was satisfactory; volume changes of 5.0% at 1.83 atom % burnup for the Zr–9.3% U alloy and <1% at 3500 Mwd/te Th–U for the Th–1.4% U alloy were observed. (auth)

25616 (GEAP–5085) STAINLESS STEEL FAILURE INVESTIGATION PROGRAM. Quarterly Progress Report No. 3, October 1, 1965–December 31, 1965. Duncan, R. N. (comp.) (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). Feb. 1966. Contract AT(04-3)-189. 40p. (EURAEC–1599). Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Work Performed under United States–Euratom Joint Research and Development Program.

Corrosion tests on type 304 stainless steel in HNO_3–Cr^{6+} to determine the effect of high gamma radiation fields (~1,000 R) indicate that the presence of high energy gamma radiation does not increase the dissolution rate of the stainless steel. Results of 24 hr corrosion tests obtained previously on irradiated and unirradiated type 304 stainless steel in boiling HNO_3–Cr^{6+} are valid and indicate that irradiation exposure increases susceptibility to corrosion. The weight loss of irradiated cladding samples was consistently higher than that of unirradiated control specimens by a factor of two. Microthermoelectric measurements across grain boundaries in nonirradiated and irradiated stainless steel were completed and indicate no significant difference between the thermoelectric properties of grains and grain boundaries. A portable autoclave system was assembled and tested in preparation for corrosion tests on irradiated type 304 stainless steel samples in 650°F, 0.1 g/l iron chloride solutions. The various irradiated samples for these tests were prepared. Electrochemical studies at elevated temperatures, up to 275°C were initiated. Potentiostatic and intensiostatic curves were obtained for type 304 stainless steel samples in deionized water and in dilute iron chloride solutions. Variations due to scan speed, temperature and different electrolytes were observed. (auth)

25617 (N–65-33370) COMBINED SPACE ENVIRONMENT EFFECTS ON TYPICAL SPACECRAFT WINDOW MATERIALS. Final Report, June 1964–June 1965. Jones, R. H. (Avco Corp., Tulsa, Okla.). July 1965. Contract NAS9-2939. 55p. (NASA-CR-65142; TR-65-351-F). CFSTI $3.00 cy, $0.50 mn.

Nine samples of prospective Apollo window materials were exposed to a simulated space radiation environment consisting of combined low energy protons (50 kev) and electromagnetic radiation, with wavelengths from 1216 angstroms in the extreme ultraviolet to two microns in the infrared. An accelerated two-week mission was simulated, assuming a solar flare to occur during the period. The purpose of the tests was to determine the optical degradation resulting from such exposure with the damage criterion being the observed change in spectral transmittance. Degradation was found to occur to varying degrees in all materials tested. Spectral transmittance curves of each material, made in situ, are presented for several increments of radiation dosage. (auth)

25618 (N–65-33506) RADIATION EFFECTS ON SILICON. Quarterly Progress Report No. 1, June 1–August 31, 1964. Snowden, D. P.; van Lint, V. A. J. (General Atomic, San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science). Sept. 10, 1964. Contract NAS7-289. 15p. (NASA-CR-64847; GACD-5678). CFSTI $1.00 cy, $0.50 mn.

Irradiated samples of n-type and p-type silicon were studied by electron spin resonance techniques. The technique for measuring lifetime as a function of injection level was refined and applied to a sample of p-type silicon. The temperature dependence of the lifetime was measured in another sample of p-type silicon by a microwave selectivity technique. (STAR)

25619 (ORNL–3949) RADIATION METALLURGY SECTION, SOLID STATE DIVISION PROGRESS REPORT FOR PERIOD ENDING FEBRUARY 1966. (Oak Ridge National Lab., Tenn.). May 1966. Contract W-7405-eng-26. 49p. Dep. mn. CFSTI $3.00 cy, $0.50 mn.

Unirradiated simulated weld heat-affected-zone samples of ASTM A-212B pressure-vessel steel corresponding to a heat input of 100,000 J/in. exhibited a ductile-brittle transition temperature at 20 ft-lbs of 60°C, which is about 80°C higher than for the base plate. Despite the higher initial ductile-brittle transition temperature, the heat-affected-zone samples for 100,000 J/in. heat input underwent an increase in ductile-brittle transition temperature of about the same magnitude as for the base plate (an increase of about 90°C after irradiation to 9×10^{18} n/cm^2, E > 1 Mev, at 70°C). Another series of heat-affected-zone samples, corresponding to 50,000 J/in., exhibited similar properties to those of the base plate before and after irradiation. Both series of heat-affected-zone samples showed poorer response to post-irradiation recovery anneals. Irradiation of ASTM A-212B steel at 235°C to about 10^{19} n/cm^2 (E > 1 Mev) produced about a 75% increase in yield stress, whereas approximately the same dose at 292°C caused an increase of only about 50%. Upon postirradiation annealing, the 292°C-irradiated samples recovered at somewhat higher temperatures and more gradually than the 235°C-irradiated samples. The dose rate effect was investigated for radiation hardening in vacuum-melted iron. For values corrected to a constant dose of 4.6×10^{18} n/cm^2 (E > 1 Mev) at 94°C and test temperature of 30°C, a three-fold increase in yield stress was observed, but over a dose-rate range from 4 to 300×10^{11} n/cm^2 (E > 1 Mev) there was only a slight tendency for greater hardening at the lower dose rates. Whether this apparent trend is real or not will be more easily decided when samples from a still lower dose-rate irradiation are tested. Results are also described for tensile tests as a function of grain size, strain rate, and postirradiation annealing. For a two-hour annealing time, the temperature for 50% recovery is about 350°C and the annealing activation energy is about 3 ev. In the investigation of dislocation dynamics in iron by stress relaxation techniques, an internal or threshold stress is determined that must be exceeded for macroscopic dislocation motion. It is found that radiation hardening in iron is governed mostly by the increase in this stress rather than a change in the stress dependence of the dislocation velocity. The stress relaxation measurements also yield a curve for the activation volume for plastic deformation as a function of effective shear stress. This curve was found to be the same for irradiated and unirradiated samples. The study of plastic deformation in single crystal niobium was continued. An electron-beam floating-zone refiner was installed and the analysis of the purity of the niobium single crystal produced in the refiner begun. A particularly striking and promising development is the success in achieving anomalous x-ray transmission or Borrmann topographs for the single crystals of niobium. These photographs enable one to see dislocations in stereo view in relatively thick samples and are an indication that the dislocation densities are quite low (less than 10^5 dislocations/cm^2). The low dislocation density is borne out by direct counting of dislocation etch pits. The etch-pitting technique was used to measure the dislocation velocity as a function of applied stress. Slip line observations were made on polished surfaces of irradiated and unirradiated niobium. They clearly show the tendency for inhomogeneous slip and the clustering of slip lines into coarse bands in irradiated samples. Stress relaxation measurements were also carried out on the single crystal niobium tensile samples. (W.L.G.)

25620 (TID–22875) EFFECTS OF NEUTRON DAMAGE ON THE MECHANICAL PROPERTIES OF PYROLYTIC AND SINGLE-CRYSTAL GRAPHITE. Quarterly Progress Report No. 4, January 1, 1966–March 31, 1966. Meers, J. T. (Union Carbide Corp., Parma, Ohio. Carbon Products Div.). Apr. 15, 1966. Contract AT(40-1)-3237. 12p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

The production of compression-annealed pyrolytic graphite disks to be used for irradiation test specimens were produced. Values of C_{33} and C_{44} that were measured and calculated by several different methods were tabulated and compared with each other and with present results obtained. Reasonable agreement for C_{33} was found among the several methods of determining elastic constants, but the measured static values of C_{44} were 13 to 35 times smaller than the values calculated from the specific heat. (P.C.H.)

25621 LENGTH CHANGES IN PROTON-IRRADIATED SILICON. Stevens, P. R. C. (Atomic Weapons Research Establishment, Aldermaston, Eng.). J. Appl. Phys., 37: 2184-5(Apr. 1966).

Measurements were made of the radioinduced length changes in n-type silicon by 12-Mev protons using a capacitance method. The results suggest a barely detectable expansion $\Delta L/L = (7 \pm 15) \times 10^{-23}$/proton/cm^2. Calculations were also made of the expected damage rates for 2-Mev electrons, 6.5-Mev protons, and 12-Mev protons. The measurement supports the idea that in the case of silicon, heavy-particle irradiation does not lead to the formation of clusters that behave differently from isolated point defects. (L.B.S.)

25622 EFFECT OF γ RADIATION ON THE DYNAMIC MECHANICAL PROPERTIES OF SILICONE RUBBERS. Traeger, R. K. (Sandia Corp., Albuquerque, N. Mex.); Castonguay, T. T. J. Appl. Polymer Sci., 10: 535-50 (Apr. 1966).

Dimethyl-, trifluoropropyl-, and high-phenyl content polysiloxanes were irradiated with a ^{60}Co source to doses of 100 Mrad. The hardness of the specimens increased with dose. Crosslink density changes did not directly reflect the hardness changes. The crosslink density of the dimethyl polymer increased significantly and that of the trifluoropropyl polymer increased only slightly. There was a slight decrease in the crosslink density of the aromatic material. The storage moduli reflected changes in crosslink density. Loss moduli of the dimethyl- and trifluoropropylpolysiloxanes initially decreased and then increased on continuing irradiation. Dynamic moduli of the polymer with high aromatic content were essentially unchanged by the radiation. All the dynamic data were correlated by the WLF time-temperature relation. (auth)

25623 NEUTRON IRRADIATION EMBRITTLEMENT OF AUSTENITIC STAINLESS STEELS AND NICKEL-BASE ALLOYS. Harries, D. R. (Atomic Energy Research Establishment, Harwell, Eng.). J. Brit. Nucl. Energy Soc., 5: 74-87(Jan. 1966).

Neutron irradiation produces grain boundary embrittlement in austenitic stainless steels and nickel base alloys at temperatures above about 600°C by forming helium atoms in the lattices by transmutation processes. The mechanisms of this high temperature irradiation embrittlement are discussed in terms of current knowledge on grain boundary fracture and the behavior of inert gases in metals and alloys. (auth)

25624 ELECTRIC CURRENT DUE TO γ-RAY IRRADIATION. Hirakawa, Hiromasa; Mizumachi, Yoshihiko (Tokyo Univ.). Jap. J. Appl. Phys., 5: 305-9(Apr. 1966).

Production of recoil electrons in material irradiated with γ rays results in an electric current flow. A simplified analysis of this effect with specific interest for γ rays below 50 Mev is given. Examples for the ^{60}Co γ rays and the accelerator-produced bremsstrahlung are shown. (auth)

25625 DYNAMIC MECHANICAL PROPERTIES OF IRRADIATED POLYVINYL CHLORIDE. Kreahling, R. P.; Kline, D. E. (Pennsylvania State Univ., University Park). Kolloid-Z., 206: 1-9(Nov. 1965).

Investigation of the dynamic mechanical properties of polyvinyl chloride (PVC) samples which were exposed to ^{60}Co γ radiation doses from 270 to 1400 Mrad is reported. These properties were studied at audiofrequencies from 80 to 450°K. Two damping peaks were observed between 80 and 400°K. The onset of main relaxation near 350°K shifted to lower temperatures at low doses, and then shifted to higher temperatures at a dose of 14 Mrad. Only slight changes were discernible in the damping peak near 250°K upon irradiation, but definite variations were noted in the modulus curves. Upon irradiation to 270 Mrad an additional damping peak appeared near 150°K accompanied by an increase in modulus at lower temperatures. The height of this peak increased with increasing radiation dose. Experiments were also made on a polyvinyl chloride composition having a slightly different formulation. In place of the styrene-acrylonitrile substituent, two parts of calcium stearate and one part of N,N′-ethylene-bis-stearamide were added. Results for the unirradiated sample showed that the secondary peak in the loss data appeared near 270°K rather than at 250°K as noted for the first formulation, and this was confirmed in the modulus data. A shift of the onset of the 350°K relaxation to higher temperatures was also noted for this PVC formulation. These results are assumed to be primarily due to the different additives in the two formulations. Cross-linking was confirmed from rubber elastic behavior, swelling, and solvent extraction studies. Some explanations for the changes occurring in the dynamic mechanical properties of irradiated PVC are given in terms of cross-linking, loss of crystallinity, and dehydrochlorination followed by the formation of conjugated series of double bonds. (BBB)

25626 STUDY OF PROCESSES TAKING PLACE IN THE COURSE OF RADIATION-INDUCED HARDENING OF VARIOUS TYPES OF UNSATURATED CONDENSATION RESINS. Egorova, Z. S.; Slovokhotova, N. A.; Karpov, V. L.; Kiselev, B. A.; Bodrova, V. V. Plast. Massy, No. 6, 18-23(1965).

Several unsaturated resins were hardened by exposure to radiation from a ^{60}Co source in air. Doses of 0.5–50 Mrad were used. Parallel hardening by thermal treatment was undertaken for comparison purposes. All the resins investigated can be divided into two categories: those that are hardened by relatively small doses of radiation (0.5–8 Mrad), and those that are not. The first category consists of unsaturated polyester resins, such as diethylene glycol maleinate phthalate and polyesters with terminal methacrylate groups, and the second category, of such resins as ethyleneglycol maleinate, epoxy resins, phenol-formaldehyde resin, and epoxy-phenolic resin. The structure of the hardened samples was studied by observing their infrared absorption spectra. Conclusions were made based on measurements of ir bands associated with carbon–carbon double bonds, eneone groups, ether and ester functions, carbonyl, and other groups. It was found that unsaturated polyester resins harden most easily under the influence of radiation. Both thermal and radioinduced hardening of unsaturated polyester resins depend on the reaction of double bonds in the resin. While irradiation of the phenol-formaldehyde resin (novolac type) solution in furfurol involves a reaction of furfurol with the diene function of the resin, thermal hardening of the same resin probably depends on the reaction of furfurol with carbonyl groups and concurrent polymerization of furfurol. (CFSTI)

25627 RADIATIVE RECOMBINATION IN SILICON CONTAINING RADIATION-INDUCED DEFECTS. Yukhnevich, A. V.; Tkachev, V. D. (Lenin Belorussian State Univ., Minsk). Soviet Phys.-Solid State (Engl. Transl.), 7: 2746-7(May 1966).

Translated from Fiz. Tverd. Tela, 7: 3410-12(Nov. 1965).

A study is presented of the mechanism of recombination through deep energy levels (which are associated with structural defects) in the forbidden band of silicon. (B.G.D.)

25628 MAGNETIC MEASUREMENTS ON NEUTRON-IRRADIATED LEAD–NICKEL ALLOYS. Moedl, Herbert; Waidelich, Wilhelm (Technische Hochschule, Darmstadt, Ger.). Z. Angew. Phys., 20: 476-8(Apr. 1966). (In German).

Neutron irradiation effects on magnetization Pb–Ni alloys were studied with a magnetic balance. Pb–Ni is a precipitation-hardening alloy. A decrease in magnetization by irradiation was found when the samples contained nickel-rich ferromagnetic precipitations. An increase in magnetization was measured, when the nickel was in solid solution. The decrease results from the destroying of precipitations in "displacement spikes" and the increase is caused by radioinduced diffusion. (auth)

25629 DEVICE FOR THE THERMAL STUDY OF SAMPLES. Bonjour, Emmanuel; Pierre, Jacques (to Commissariat a l'Energie Atomique). Canadian Patent 723,384. Dec. 14, 1965. Priority date Apr. 26, 1963, France.

The internal energy in metals or graphite conferred by radiation (Wigner energy) or some other treatment is measured with the device described. The temperature range of the Dewar calorimeter is given as 20 to 750°K. The heat output of a treated sample for given heat input was measured and compared with that of an identical but untreated (no radiation) sample. Small discs were cut from a rod of material about 20 mm in diameter and 2 mm thick to serve as samples. Thermocouples, circuits, and the general arrangement of the equipment are described. (F.S.A.)

PHYSICS

General

25630 SOME DYNAMICAL PROPERTIES OF LINEAR MAGNETIC CHAINS. I. Kawasaki, Kyozi (Massachusetts Inst. of Tech., Cambridge). Ann. Phys. (N. Y.), 37: 142-75(Mar. 1966).

The dynamical properties of a linear chain of spins of magnitude ½ described by the Hamiltonian

$$H = \sum_{l=1}^{N} [\alpha(S_l^x S_{l+1}^x + S_l^y S_{l+1}^y) + \gamma S_l^z S_{l+1}^z]$$

were studied by making use of the fact that this system is equivalent to a one-dimensional assembly of interacting Fermi particles with the strength of interaction proportional to $|\gamma|$. The case with $|\gamma| \ll |\alpha|$ was treated by setting up a suitable kinetic equation for the particle distribution function in which the transformation properties of various quantities under the symmetry operations of the system have been found to play a rather important role. The spin density and the energy density show diffusive or sound wavelike oscillatory motions depending on the magnitudes of the wave vectors characterizing the scales of inhomogeneous disturbances. The extension of the work to systems with larger $|\gamma|$ is suggested from the standpoint of the Landau theory of Fermi liquids. (auth)

25631 THETA-PINCH DISCHARGE AS SPECTROSCOPIC LIGHT SOURCE. Bockasten, Kjell; Hallin, Reinhold; Nilsson, N. Robert (Univ. of Uppsala). Ark. Fys., 32: 437-48(1966).

The construction and operation of a 2 kilojoules theta-pinch is described. It is used as a spectroscopic light source for the investigation of highly ionized spectra from gases in the wavelength region 200–8000 Å. A low-pressure spark gap was developed and the discharge conditions were optimized to give clean spectrograms with good line quality. A method of removing higher order spectra below 1200 Å was developed using helium or argon as absorber in the vacuum spectrograph. A simple quartz order-sorter is also described. (auth)

25632 KINETIC EQUATIONS. Pratap, R.; Radhakrishnan, V. (Tata Inst. of Fundamental Research, Bombay). Bull. Cl. Sci., Acad. Roy. Belg., (5), 51: 726-34 (1965).

The derivation of the Boltzmann function $f(\vec{r}, \vec{c}, t)$ from the Liouville density D_N is shown to be equivalent to a transition from Γ space to μ space. In this formulation, the collision is left in all its generality. This enables one to define a most probable distribution function even when the collision term is not set to zero. (auth)

25633 MAGNETIC CUMULATION. Sakharov, A. D.; Lyudaev, R. Z.; Smirnov, E. N.; Plyushchev, Yu. I.; Pavlovskii, A. I.; Chernyshev, V. K.; Feoktistova, E. A.; Zharinov, E. I.; Zysin, Yu. A. Dokl. Akad. Nauk SSSR, 165: 65-8(Nov. 1, 1965). (In Russian).

Experiments with the MK-1 and MK-2 explosion devices for the production of very high magnetic field pulses are discussed. The MK-1 device, which is based on the implosion of an axial flux within a metal shell, and the MK-2, which works on the principle of the expulsion of the field from the solenoid and the subsequent compression of the field by the walls of the coaxial liner, are described. Field intensities of 1×10^6 Oe were obtained in experiments with an MK-1 using aluminum liners about 100 mm in diameter. In a subsequent experiment with a stainless steel liner with a copper plated inner surface, a field intensity of 25×10^6 Oe was achieved by imploding a liner to a 4-mm diameter. A field intensity of 5×10^6 Oe in a volume of 100 cm^3 was produced by a copper liner 300 mm in diameter, using the MK-2 as the source of the initial field. (ATD)

25634 INSTABILITIES IN A NEUTRALIZED ELECTRON STREAM IN A FINITE-LENGTH DRIFT TUBE. Frey, Jeffrey; Birdsall, C. K. (Univ. of California, Berkeley). Contract 49(638)102. J. Appl. Phys., 37: 2051-61(Apr. 1966).

Instabilities in one and two drifting-electron streams neutralized by nondrifting ions and bounded transversely and axially are presented in mathematical and physical detail. Solutions for growth rates are obtained from the dispersion relation for a cylindrical stream of cold electrons and cold ions plus the boundary conditions at the gridded ends of the drift region. The new results in addition to the critical current (or critical perveance = 190×10^{-6}) given by Pierce in 1944 are: (i) less approximate inclusion of finite drift length, (ii) a-c motion of ions, (iii) detailed physical description, (iv) growth rates over a range of parameters. The results show instability for immobile ions with the critical perveance value agreeing with that given by Pierce, but show marginal stability for mobile ions, contrary to Pierce and to the experiments of Atkinson. The difference between mobile and immobile ion solutions is ascribed to the ability of ions to neutralize (or not) excess electron charge in the vicinity of the output grid. The relation to stream-ion wave amplification is discussed. The relation of the solutions presented here to those for a cylindrical stream which is not neutralized but is thin enough to have only small velocity variation radially is also discussed. (auth)

25635 UNSATURATED O-SHAPED MAGNETIC SYSTEM WITH TWO EXCITING WINDINGS FOR MHD-MACHINES. Kachanov, P. V. Magnit. Gidrodin., No. 1, 142-5(1966). (In Russian).

O-shaped magnetic systems with unsaturated steel core for achieving strong and uniform magnetic fields are considered. It is shown that a strong magnetic field in square grooves can be obtained if the distribution of the current sheet along the perimeter is homogeneous and the core is unsaturated. (auth)

25636 HARD X-RAYS FROM EXPLODING WIRES. Haendel, S. K.; Stenerhag, B.; Holmstroem, I. (Univ. of Uppsala). Nature, 209: 1227-8(Mar. 19, 1966).

An experiment is described for correlated electric and x ray measurements of exploding tungsten wires in a vacuum. (B.G.D.)

25637 ION-OPTICAL SYSTEM FOR REDUCING THE TRANSVERSE DIVERGENCY IN HEAVY ION BEAMS. Hortig, G. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Z. Phys., 192: 257-63(1966). (In German).

An ion-optical system of new type capable to reduce the divergency of heavy ion beams is proposed. The action of this system is based on the difference of mean charge of heavy ions in gas and in condensed matter. The beam is split into two parts of different mean charge and merged by unification of the mean charge alternately by local application of the different charge exchange media. Considering the beam to be bound to an axis by a series of identical coaxial lenses the ions will oscillate around the axis. Since one part of the beam remains unaffected by charge exchange processes on the average the particles of the other part are forced to increase their charges at positions near to the center line and to reduce their charges at positions of maximum elongation. This process will absorb oscillation energy from the beam. Also, the coordinates of the particles of the second part of the beam move differently in phase space while the particles are in higher charge states: the coordinates are shifted into the phase space domain occupied by the coordinates of the particles of the first part of the beam thus yielding an overall reduction of beam divergency. (auth)

25638 THEORY OF THE TRANSVERSE COMPLEX PARAMAGNETIC SUSCEPTIBILITY. Kadyrov, D. I. (Permian State Univ., USSR). Zh. Eksp. Teor. Fiz., 50: 759-64(Mar. 1966). (In Russian).

The perturbation theory developed for two-time temper-

ature Green functions are employed for calculating the paramagnetic relaxation function and complex transverse magnetic susceptibility. Use of the Dyson-Dembinsky representation for spin operators is essential in this case. Near resonance the susceptibility expression obtained for not very small stationary fields is the same as that which the phenomenological theory yields. (auth)

25639 EFFECTIVE POTENTIAL FOR MOTION OF PARTICLES IN A HIGH FREQUENCY FIELD. Klima, R. Zh. Eksp. Teor. Fiz., 50: 807-8(Mar. 1966). (In Russian).

A general expression is derived for the effective potential for motion of a charged particle in high-frequency electromagnetic fields. The amplitude of the high-frequency field is assumed to be sufficiently small. (auth)

25640 EXACT SOLUTIONS OF EQUATIONS FOR A STATIONARY MONOENERGETIC BEAM OF CHARGED PARTICLES. Syrovoi, V. A. Zh. Prikl. Mekh. Tekh. Fiz., No. 6, 3-9(Nov.-Dec. 1965). (In Russian).

A class of invariant solutions which can describe only vortex flows are examined. It is shown that among the solutions are those which correspond to flows from a plane or cylindrical emitter upon a voltage drop across it under temperature-limited operating conditions. The emission limited by temperature is denoted as "emission under T-conditions." A solution is obtained in an analytical form for emission from a plane in a homogeneous magnetic field perpendicular to the flow plane. The solution defines a plane magnetron under T-conditions. The solution of the problem for a cylindrical emitter is reduced to an examination of equations describing a cylindrical diode or magnetron under T-conditions; the shape of the collector is given by the distribution curve of the potential for these cases. The results can be extended to a relativistic beam if limitations are applied to its relative dimensions which permit disregarding the proper magnetic field. Brillouin-type flows, including nonvortical, in which the particles move, without intersecting equipotential surfaces, along three-dimensional spirals situated on the surface of cones are investigated, and an analytic solution for a relativistic Brillouin flow in a conic diode with rigorous consideration of the proper magnetic field is given. (ATD)

25641 FUNDAMENTALS OF X-RAY AND RADIUM PHYSICS (FOURTH EDITION). Selman, Joseph. Springfield, Ill., Charles C Thomas Publisher, 1965. 487p.

The basic principles of chemistry and physics are presented in detail. The principles of mathematics, units of measurement in physics, the physical concept of energy, structure of matter, static and current electricity, magnetism, electromagnetism, electric generators and motors, production and control of high voltage, and rectification are discussed. Also covered are x rays, modern x-ray, radiographic, and therapy tubes, x-ray circuits and film, film holders, intensifying screens, the darkroom, the chemistry of radiography, film processing, radiographic quality, radioactivity, radium, radioactive isotopes, artificial radioactivity, and health physics. (J.F.P.)

25642 PRELUDES IN THEORETICAL PHYSICS. De-Shalit, A.; Feshbach, H.; Van Hove, L. (eds.). Amsterdam, North-Holland Publishing Company, 1966. 361p. John Wiley and Sons, Inc., New York.

Forty-two papers are presented. Separate abstracts have been prepared for each paper. (B.G.D.)

For abstracts of individual papers see: 25643–25647, 25750, 25869–25877, 25937–25949, 26015–26021, 26078, and 26233–26238.

25643 UNITARY DESCRIPTION OF HOMOGENEOUS LORENTZ GROUPS. Fierz, Markus (Eidgenoessische Technische Hochschule, Zurich). pp 1-4 of Preludes in Theoretical Physics. Amsterdam, North-Holland Publishing Co., 1966. (In German).

A simple method is presented that leads to the irreducible unitary representation of the homogeneous Lorentz group. As object of the Lorentz transformations, the field strength E and B and the broadening vector p of a plane electromagnetic wave at a fixed point of space and time is used. (J.S.R.)

25644 CAUSALITY AND DISPERSION RELATIONS. (A DIALOGUE ON CLASSICAL PHYSICS). Hagedorn, R. (CERN, Geneva). pp 154-65 of Preludes in Theoretical Physics. Amsterdam, North-Holland Publishing Co., 1966.

A ficticious dialogue between a theoretical and an applied physicist on causality and dispersion relations is presented. (B.G.D.)

25645 ROLE OF PHENOMENOLOGICAL THEORY IN SYSTEMS OF THEORETICAL PHYSICS. Heisenberg, W. pp 166-9 of Preludes in Theoretical Physics. Amsterdam, North-Holland Publishing Co., 1966. (In German).

A brief philosophical review is given of the role of the phenomenological theory in systems of theoretical physics. Examples of the use of the theory are summarized. (J.S.R.)

25646 ENERGIES AND HAMILTONIANS IN MAGNETIC FIELDS. Casimir, H. B. G. pp 287-93 of Preludes in Theoretical Physics. Amsterdam, North-Holland Publishing Co., 1966.

A brief outline is presented on energies and hamiltonians in magnetic fields. Topics discussed are the problems of magnetic work on a body in a magnetic field, thermal equilibrium in a constant magnetic field, energies from hamiltonians for a system in an external magnetic field, magnetic interaction energies, constant magnetization inside a sphere, and hamiltonians for two coupled systems. (B.G.D.)

25647 TIME'S ARROW AND EXTERNAL PERTURBATIONS. Morrison, P. (Massachusetts Inst. of Tech., Cambridge). pp 347-51 of Preludes in Theoretical Physics. Amsterdam, North-Holland Publishing Co., 1966.

A discussion of coarse graining, or averaging, in statistical mechanics and its effect on the uniformity of equilibrium is presented. The main idea presented in this discussion is that every classical statement of the laws of motion of any system necessarily leaves out a small physical perturbation, which cannot in principle be included for finite systems, and which in fact is always amply large enough to prevent a complete retracing. (B.G.D.)

25648 HIGH OUTPUT DUOPLASMATRON-TYPE ION SOURCE. Kelley, G. G.; Morgan, O. B. Jr. (to U. S. Atomic Energy Commission). U. S. Patent 3,238,414. Mar. 1, 1966.

A high-output duoplasmatron-type ion source is described which comprises providing a plasma-expansion cup as part of the anode structure, providing electron dumps in the region between the anode and the extracting electrode, feeding gas into the region between the intermediate electrode and anode, and providing a solenoid focusing magnet in conjunction with a smaller solenoidal magnet encompassing the above plasma expansion cup to provide a magnetic field nearly zero at the exit of the cup. The above modifications provide an output from the ion source which is about double to that achieved with prior ion sources. (AEC)

Accelerators

Refer also to abstract 25788.

25649 (AECD-HP-4) RADIATION LEVELS AROUND THE 3-Mev DACCA VAN DE GRAAF GENERATOR. Abdullah, S. A.; Hossain, A.; Hussain, M.; Siddiqi, A. A. (Atomic Energy Centre, Dacca (Pakistan)). Feb. 1966. 11p. Dep. mn.

An estimate of the gamma radiation level at different places within the Van de Graaff generator room was made with the help of gamma monitors for the purpose of safety of personnel working around the machine. The measurements were conducted with the machine operating at 2 Mev with different beam currents. From the readings, isodose curves were drawn. It was interesting to find that the dose rate was high not only at the back end of the machine as expected but also at one side of the Van de Graaff. (auth)

25650 (DESY–65/18) LANGSAME EJEKTION BEIM DEUTSCHEN ELEKTRONEN-SYNCHROTRON. (Slow Ejection by German Electron Synchrotron). Brasse, F. W.; Hemmie, G.; Schmidt, W. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Dec. 1965. 52p. Dep. mn.

Calculations for slow ejection are given on the basis of using a current sheet for generating a betatron resonance. The apparatus is outlined briefly. First measurements of ejection efficiency and emittance of the first ejected electron beam are reported. (auth)

25651 (DESY–66/3) SKYSHINE-MESSUNGEN UND IHR VERGLEICH MIT ABSCHAETZUNGEN AUS DER DIFFUSIONSTHEORIE. (Skyshine Measurement and its Comparison with Estimates from Diffusion Theory). Bathow, G.; Clausen, U.; Freytag, E.; Tesch, K. (Deutsches Elektronen-Synchroton, Hamburg (West Germany)). Feb. 1966. 18p. Dep. mn.

The neutron flux density caused by backscatter from the air (skyshine) was measured. The results, as well as measurements made at other accelerators, are compared with estimates obtained using diffusion theory. The parameters necessary for a straightforward calculation of skyshine are discussed. (auth)

25652 (DESY–66/5) MEASUREMENT OF SYNCHROTRON RADIATION IN THE X-RAY REGION. Bathow, G.; Freytag, E. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany); Haensel, R. (Physikalisches Staatsinstitut, Hamburg (West Germany). Hamburg Univ. (West Germany). II. Institut fuer Experimentalphysik). Feb. 1966. 24p. Dep. mn.

At the Deutsches Elektronen-Synchrotron DESY synchrotron radiation was investigated by means of scintillation counters at electron energies between 4.0 and 6.3 Bev. Measurements were performed of the integrated radiation the spectral distribution, the polarization and the angular dependence of them at photon energies between 15 and 300 kev. The results agree with theoretical calculations. (auth)

25653 (JINR–P-2588) MAGNITNYI KANAL DLYA FOKUSIROVKI OTKLONENNOGO PUCHKA TSIKLOTRONA. (Magnetic Channel for Focusing a Deflected Cyclotron Beam). Danilov, V. I.; Zager, B. A.; Linev, A. F.; Shelaev, I. A. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1966. 7p. Dep. mn.

An extraction beam system of the 1.5-meter JINR cyclotron meant for heavy-ion acceleration is described. It is shown that the use of the magnetic channel for the focusing of the deflected beam passing through the deflected plate of a hyperbolic shape allows one to obtain an extraction coefficient of about 60%. (auth)

25654 (LNF–65/48) UN DISPOSITIVO PER LA FOCALIZZAZIONE E L'ANALISI MAGNETICA DI PIONI CA RICHI FOTOPRODOTTI DALL'ELETTROSINCROTRONE DI FRASCATI. PARTE III. CONTROLLO DELLE PROPRIETA' OTTICHE DEI MAGNETI MEDIANTE UN ODOSCOPIO A FILO. (An Apparatus for the Focusing and Magnetic Analysis of Charged Pions Photoproduced by the Frascati Electron Synchrotron. Part III. Control of the Optical Property of the Magnet by Means of a Wire Hodoscope. Note No. 300). (Laboratori Nazionali di Frascati, Comitato Nazionale per l'Energia Nucleare (Italy)). Dec. 20, 1965. 45p. Dep. mn.

A hodoscope adapted to the detection of the trajectory taken by a charged particle crossing a magnetic field is described. The results of the trajectory measurements made with this hodoscope on the electromagnets are reported. The principle of the hodoscope and the formal analogy between the trajectory of the charged particle and the equilibrium configuration of a taut wire with a current flow are given. The limits of validity of this analogy and the effect and the entirety of the perturbing effects present are discussed. The construction of the hodoscope is then described. The control measurement of the optical properties of the quadrupole lens and the analyzing magnets are reported. The conclusions from the comparison between the results obtained and the predictions on the optical behavior of the magnets made on the basis of the efficient model are reported. (tr-auth)

25655 (NP–15656) EXPERIENCES SUR L'ANNEAU DE COLLISIONS AdA [Theses]. (Experiments on the AdA Collisions Ring [Thesis]). Haissinski, Jacques (Paris Univ., Orsay (France). Faculte des Sciences). [1965]. 136p. Dep. mn.

The experiments made at Orsay on the AdA collision ring are reported. A description is first given of the AdA, and the injection of electrons and positrons is described. The properties of the orbit and the beam are derived and the number of stored particles is determined. The lifetime of the particles in the collision ring was studied. Investigations on beam-beam interactions are reported. (J.S.R.)

25656 (SLAC–59) TWO-MILE ACCELERATOR PROJECT. Quarterly Status Report, October 1–December 31, 1965. (Stanford Linear Accelerator Center, Stanford Univ., Calif.). Mar. 1966. Contracts AT(04-3)-400; AT(04-3)-515. 97p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

Further development of the accelerator is reported in terms of the following: plant engineering, systems engineering and installations, accelerator physics, instrumentation and control, heavy electronics, mechanical design and fabrication, klystron studies, accelerator operations, beam switchyard, research area operations, and preoperations research and development. (M.O.W.)

25657 (SLAC-PUB–179) SIMILARITY OF SHIELDING PROBLEMS AT ELECTRON AND PROTON ACCELERATORS. DeStaebler, H. (Stanford Linear Accelerator Center, Stanford Univ., Calif.). Dec. 1965. Contract AT(04-3)-400. 18p. (CONF-651109–22). CFSTI $1.00 cy, $0.50 mn.

From 1st Symposium on Accelerator Radiation Dosimetry and Experience, Upton, N. Y.

The similarities between the shielding problems at a high-energy, high-beam-power electron accelerator and those at a high-energy proton accelerator are discussed with reference to the electron-photon cascade and the photoproduction of muons and neutrons. (M.O.W.)

25658 (SLAC-TN–66-4) ACTIVATION OF WATER DURING BEAM TESTS. McCall, Richard C. (Stanford Linear Accelerator Center, Stanford Univ., Calif.). Jan. 1966. Contract AT(04-3)-400. 3p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

During beam tests with SLAC sectors 1 and 2, experiments were performed using a BSY protection collimator as the straight-ahead beam dump. Sectors 1 and 2 cooling loops has approximately 400 gallons of water and a bypass demineralizer attached. Water samples were taken from the loops and were analyzed for possible radioactivity. A brief discussion of results is presented. (M.O.W.)

25659 (UCRL–16708) AUTOMATIC CONTROL OF THE TRIM-COIL POWER SUPPLIES AT THE BERKELEY 88-INCH CYCLOTRON. Struthers, David R. (Lawrence Radiation Lab., Univ. of California, Berkeley). Apr. 7, 1966. Contract W-7405-eng-48. 11p. (CONF-660510–3). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From International Conference on Isochronous Cyclotrons, Gatlinburg, Tenn.

The automatic-control requirements of the 88-inch cyclotron trim-coil power supplies resemble those of many industrial processes. Certain set points must be automatically realized and maintained throughout an extended experimental run. The recently installed system reduces trim-coil setup time to less than 5 min, and maintains these set points within 0.1% or less over an 8-hour period. Although the system is primarily analog, the set points for a run are programmed on an IBM card and entered into the system through a digital-to-analog interface. The system is being extended to include the many machine-parameters—such as the deflector positions and voltages—that have set points. (auth)

25660 (UCRL–16726) THE BERKELEY 88-INCH CYCLOTRON: PROGRESS AND STATUS, FEBRUARY 1966. Conzett, H. E.; Harvey, B. G. (Lawrence Radiation Lab., Univ. of California, Berkeley). Feb. 1966. Contract W-7405-eng-48. 10p. (CONF-660510–1). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From International Conference on Isochronous Cyclotrons, Gatlinburg, Tenn.

A general description of the cyclotron and its experimental facilities is given. The planned improvement and research scheduled are outlined. (M.O.W.)

25661 OPTICAL DIAGRAMS FOR ELECTROSTATIC LENSES APPLIED IN HIGH VOLTAGE ACCELERATORS. **Koltay, E.; Czegledy, S. (Inst. of Nuclear Research, Hungarian Academy of Sciences, Debrecen). Acta Phys. Acad. Sci. Hung., 20: 341-50(1966).**

Optical data for two similar electrode configurations generally used as electrostatic lenses in high current cascade generators are presented in the form of P–Q diagrams and cardinal characteristic obtained by the application of the Gans' method. (auth)

25662 APPARATUS TO IRRADIATE SOLIDS WITH PROTONS OF VARIABLE ENERGY. Schmidtke, M. (Technische Hochschule, Munich). Atomkernenergie, 11: 243-5(May-June 1966). (In German).

An energy resolving power of 0.15% is obtained by magnetic deflection of the protons from a Tandem-Van de Graaff-Accelerator. The energy-selected proton current is 1×10^{-8} amp. Application of the accelerator for irradiation of solids with protons of variable energy is described. (auth)

25663 HIGH-FREQUENCY ION SOURCE OF LOW CONSUMPTION FOR PRESSURIZED ACCELERATORS. Nagy, Janos. ATOMKI (Atommag Kut. Intez.) Kozlem., 7: 209-19(Dec, 1965). (In Hungarian).

A high-frequency ion source with a 50-G transverse magnetic field using a previously developed extraction system is described. A forced ion beam of 10- to 100-amp intensity and with a H^+ ion content of 57% was obtained at a gas consumption of 2.5 cm^3/hr and a total electric power of 200 w supplied by a small 200-w 400-cps generator. The excellent stability of the ion source, shown in its operation for a few hundred hours, and its mechanical construction, which is able to withstand high pressure differences, permit the source to be used in pressurized Van de Graaff accelerators. (auth)

25664 QUANTUM DEPOLARIZATION OF ELECTRONS IN A MAGNETIC FIELD. **Baier, V. N.; Orlov, Yu. F. (Novosibirsk State Univ., USSR). Dokl. Akad. Nauk SSSR, 165: 783-5(Dec. 1, 1965). (In Russian).**

The depolarization of electrons and positrons in modern storage rings are shown to be caused not only by resonance due to radial and azimuthal components of the magnetic field on the particle trajectories, but also by the quantum nature of the radiation. The latter depolarization occurs also only in the presence of perturbing radial and azimuthal field components, but is produced by harmonics which cannot be eliminated by suitable choice of the energy. Calculations show that the effect depends very strongly on the particle energy and on the number of closest harmonic of the radiation, the distance between the harmonic and the resonance, and on the vertical displacement of the particle in the orbit. It is shown by way of an example that in a typical storage ring the characteristic depolarization time is one order of magnitude lower than the polarization time, so that in this case the beam can become readily depolarized unless special measures are adopted to maintain the beam polarization. (ATD)

25665 NEW METHOD OF INCREASING X-RAY YIELD OF BETATRONS. **Yamanouchi, Mikio (Tokyo Univ. of Education). Jap. J. Appl. Phys., 5: 344-5(Apr. 1966).**

A method of increasing the x-ray yield of betatrons is described. This method uses a system of focusing magnetic lenses placed along the betatron orbit. Preliminary data on the effect of the lens system on the x-ray yield are shown in which the yield values for various combinations of lens units are plotted against the acceleration voltage of the injector. (J.F.P.)

25666 NEW TYPE OF ACCELERATOR FOR HEAVY IONS. **Janes, G. S.; Levy, R. H.; Bethe, H. A.; Feld, B. T. (Avco-Everett Research Lab., Everett, Mass.). Contract AF49(638)-1553. Phys. Rev., 145: 925-52 (May 20, 1966).**

A new device, called the heavy ion plasma accelerator (HIPAC), which may be capable of accelerating ions of any atomic number to energies sufficient to overcome the nuclear Coulomb barrier, is described. A closed potential well is created by filling a toroidal vacuum chamber with electrons; the electrons are contained by a magnetic field whose intensity is so low that its effect on the ions can be neglected. Ions are both accelerated and trapped in the well; the trapping effect allows sufficient time for the ions to become highly stripped by electron impact. The very large ion energies that can be achieved in this way would allow a wide variety of nuclear reactions to be studied, including inverse fission. The present primitive state of development of the HIPAC is described, and the future prospects assessed. (auth)

25667 ALTERNATING GRADIENT ELECTROSTATIC ACCELERATING TUBE. **Boyd, D. (State Univ., New Brunswick, N. J); Kane, J. V. Rev. Sci. Instrum., 37: 555-8(May 1966).**

The processes of electron multiplication and electron loading in acceleration tubes were investigated theoretically. These effects limit the maximum voltage at which Van de Graaff generators can operate. A design for an accelerating tube is proposed which by virtue of its closely spaced electrodes has the advantage of ease of calculation and flexibility of boundary condition. Computer calculations were done for this tube to study electron multiplication trajectories. It was found that an axial alternating electric field gradient can limit such avalanches by periodically trapping the electrons. (auth)

25668 DISPERSION RELATION AND FREQUENCY CHARACTERISTICS OF ALTERNATING PERIODIC STRUCTURE FOR LINEAR ACCELERATORS. **Nishikawa, T.; Giordano, S.; Carter, D. (Brookhaven National Lab., Upton, N. Y.). Rev. Sci. Instrum., 37: 652-61 (May 1966).**

For linear acceleration of high-energy protons, an alternating periodic structure operated in a $\frac{1}{2}\pi$ standing wave mode has the advantage of relative immunity from beam loading and detuning effects while sacrificing little in shunt impedance when compared to π mode operation in a uniform periodic structure. The dispersion curve of the alternating periodic structure is derived from an analysis of a chain of coupled cavities, in each of which the fields are expanded in normal modes. By introducing the effect of coupling between alternate cells in addition to adjacent cell coupling, the passband of any one cavity mode is then found to split into two unequal passbands separated by a stop band, the width of which depends on the structure's geometrical parameters. The relative distribution of energy between cells is also found as a function of frequency. Measured dispersion curves were used to check the theory and the dependence of theoretical parameters on structure geometry. It is shown that the stop band may be reduced or eliminated simply by introducing a fixed detuning of one of the two different alternating periodic cells. It is also shown that the advantages of reduced beam loading and detuning effects resulting from operation in the $\frac{1}{2}\pi$ mode is obtained even when the group velocity vanishes, as occurs in a split passband. (auth)

25669 140-Mev ELECTRON SYNCHROTRON OF THE PHYSICAL-TECHNICAL FEDERAL INSTALLATION. I. GENERAL DATA AND MAGNET CONSTRUCTION. **Reich, Herbert; Trier, Jost Otto; Auch, Karl (Physikalisch-Technische Bundesanstalt, Brunswick). Z. Angew. Phys., 20: 435-42(Apr. 1966). (In German).**

The 140 Mev electron synchrotron of the PTB was developed for the purpose of research on dosimetry of bremsstrahlung and electron radiation below 100 Mev, and on nuclear reactions up to the meson threshold at 140 Mev. Some features of the machine are the use of a 2.3-Mev microtron as external injector, rotational symmetry of the magnetic guide field, and a nearly continuous distribution of the outside lying yoke. After six years of

construction, the synchrotron was set into operation in October 1964. At present, a mean beam current of some 10^{-8} amp is reached, which is planned to be enlarged in the future. A survey is given of the advantages and limits of a synchrotron as compared with a linac. Then the magnet design and model studies are described. (auth)

25670 PERIODIC ELECTROSTATIC FOCUSING OF A LAMINAR BEAM. Syrovoi, V. A. Zh. Prikl. Mekh. Tekh. Fiz., No. 4, 3-9(July-Aug. 1965). (In Russian).

A brief discussion of the literature concerning the solutions to various problems arising in the study of beams generated by emitters is presented. Applications to focusing of beams are reviewed. The problem selected for detailed discussion deals with the solution for the case of a beam moving in the interelectrode space where an electric potential having an extremum appears. Equipotential surfaces are derived. The suggested electrode shapes are found. In addition, the case of a virtual emitter between the electrodes is discussed. The results obtained in the single-extremum case are used to solve the problem of a laminar beam in a periodically focusing structure. Spatial potential distributions for such focusing are derived and one possible focusing scheme is given. (ATD)

25671 MAXIMUM CURRENTS IN A PLASMA BETATRON. Stefanovskii, A. M. Zh. Prikl. Mekh. Tekh. Fiz., No. 4, 21-6(July-Aug. 1965). (In Russian).

A theoretical calculation of the maximum relativistic currents that can be produced in a plasma betatron and their dependence on conditions in the betatron are presented. To obtain the desired behavior of the accelerated electrons, a balance must exist among the radial forces acting on the electron (and ion) beams in the plasma. The conditions for the balance are obtained from the relativistic azimuthal and radial equations of motion for ions and electrons. These equations contain inductive terms associated with the magnetic field of the electron beam. It is shown that the results apply in practical cases to those cases where longitudinal magnetic fields exist. In addition to the external and self-fields of the system, acceleration is effected by the appearance of instabilities caused by the electrons interacting with waves. The effect of electrostatic and spiral waves connected with toroidal magnetic fields are considered. The time when the electron beam reaches the container wall is computed for several sets of betatron parameters. It is shown that the ion inertia leads to a considerable increase in the maximum possible electron current. (ATD)

25672 IMPROVEMENTS IN OR RELATING TO APPARATUS FOR INDICATING AND/OR CONTROLLING THE POSITION OF A CHARGED PARTICLE BEAM. Poole, Michael John; Williams, Patrick John (to United Kingdom Atomic Energy Authority). British Patent 1,025,352. Apr. 6, 1966. Filed Mar. 28, 1961.

An apparatus for indicating and/or controlling the position of a modulated beam of charged particles relative to a desired axis includes a ring of magnetic material arranged in a plane normal to and with its center on the desired axis. Coil means are arranged inside the ring to couple with those magnetic field lines emerging from the ring owing to the displacement of the beam from the desired axis. The coil means includes two coils disposed at the two ends of a diameter of the ring with the two coils connected in series. When the beam is displaced from the desired position, the electric signal developed in the coil means actuates means to indicate and/or control the position of the beam. (B.L.M.)

25673 ARRANGEMENT OF ONE OR MORE IONIZATION CHAMBERS IN A PULSED LINEAR ACCELERATOR. Leboutet, Hubert; Jean, Roger (to Compagnie Generale de Telegraphie sans Fil). German Patent 1,209,219. Jan. 20, 1966. Priority date Sept. 7, 1961, France.

The beam position and/or intensity is monitored by means of annular ionization chambers located within the accelerator housing and surrounding the beam. (Gmelin Inst.)

25674 APPARATUS FOR REGULATION OF THE DEFLECTION OF THE ELECTRON BEAM OF A PARTICLE ACCELERATOR IN HORIZONTAL STRUCTURAL MANNER. Franke, Siegfried; Grosse, Siegfried; Torge, Bernd-Dietrich (to VEB Transformatoren- und Roentgenwerk Dresden). German Patent 1,211,727. Mar. 3, 1966. Filed Nov. 14, 1964.

An apparatus for scanning a surface with a beam of electrons was designed to bend a beam of electrons of an accelerator positioned horizontally through an angle of 90° and to cause the bent electron beam to scan across the surface of materials to be irradiated. The magnet positioned at the exit of the accelerator is a combination of a d-c electromagnet for bending the beam through an angle of 90° and an a-c electromagnet for deflecting the bent beam back and forth in a direction perpendicular to the axis of the bent electron beam. A circuit arrangement is given for controlling the d-c power supply as well as the amplitude of the magnetic field of the scanning magnet in relation to the output voltage of interceptors located in front of the electron window. (Gmelin Inst.)

25675 CYCLOTRON ION SOURCE. Jeppson, Morris R. (to High Voltage Engineering Corp.). U. S. Patent 3,239,707. Mar. 8, 1966. Filed Mar. 1, 1962.

An ion source for a cyclotron includes a remotely located means for generating a neutral beam. This remote generating means includes in a vacuum chamber a supply of gas to be ionized, means for ionizing the gas, a first electrode adapted to focus and collimate the ions, a second electrode adapted to accelerate the ions, a charge exchange canal aligned to accept the passage through it of the ion beam, and a quantity of charge exchange gas disposed within the charge exchange canal. A charge exchange chamber is centrally located within the cyclotron and consists of a gas filled hollow cylindrical member having apertures in it. The apertures are positioned to admit the projection of the neutral beam through it. Conduit means couple the generating means with the cyclotron and are adapted to align the neutral beam with the charge exchange chamber apertures. (B.L.M.)

25676 SPATIAL DISCRIMINATOR FOR PARTICLE BEAMS. Wiley, William C.; Thompson, Robert R.; Goodrich, George W. (to Bendix Corp.). U. S. Patent 3,240,931. Mar. 15, 1966. Filed Sept. 28, 1962.

An array of channel electron multipliers are positioned in an apparatus so as to receive particles from a particle beam, multiply the particles through secondary emission, and detect the particles at the output of the channels to provide an indication of the content of the beam. Due to the small size of the channels (diameter less than 0.010 in.) and the multiplication provided in the channels, very accurate measurement of the cross section of the beam and of low intensity and low energy beams can be made with the apparatus. A number of bismuth-lead oxide glass tubes of very small diameter, such as .001 in., are placed in a hydrogen reducing furnace to reduce the bismuth and lead oxides to convert the glass tubes from an insulator to a semi-conductor of relatively high resistance. A sufficient number of the tubes are stacked in parallel array and fused together. A relatively thin wafer, such as .050 in., is then sliced from the fused tube in a direction perpendicular to the axis of the tubes to form the multipliers. (B.L.M.)

Astrophysics and Cosmology

Refer also to abstracts 25310, 25997, 26010, and 26011.

25677 (N-66-15458) THE KINETIC PROPERTIES OF THE GALACTIC COSMIC-RAY GAS. Parker, E. N. (Enrico Fermi Inst. for Nuclear Studies, Univ. of Chicago, Ill.). [1965]. 18p. (NASA-CR-69378; EFINS-65-103). CFSTI $1.00 cy, $0.50 mn.

The elementary formulas for the pressure and the speed of sound in a statistically isotropic homogeneous cosmic-ray gas are derived. Cosmic-ray observations near Earth give a cosmic-ray energy density of 1.29×10^{-12} ergs/cm^3, a pressure of 0.45×10^{-12} dynes/cm^2, and a compressibility $\delta P/\delta N = 0.66 \times 10^{-12}$ ergs/cm^3. There is reason to believe

that the interstellar values are not significantly higher than near Earth. (STAR)

25678 THE INTERNAL CONSTITUTION OF SUPERSTARS. I. THEORY. **Haemeen-Anttila, K. A.; Anttila, Erkki. Ann. Acad. Sci. Fenn., Ser. A VI, 191: 1-24(1966).**

The theory of stellar structure is presented in relativistic form including the relativistic equations of state for stellar gas and the relativistic theory of radiative transfer. Supermassive relativistic stars are shown to be composed of an ideal gas. Numerical estimates of some stellar quantities are given. The fully relativistic theory qualitatively confirms the conclusions made earlier by means of classical astrophysics, although the relativistic effects may be large. (auth)

25679 THE RELATIVISTIC ROSSELAND MEAN OPACITY. **Haemeen-Anttila, K. A. Ann. Acad. Sci. Fenn., Ser. A VI, 192: 1-6(1966).**

As a supplement to the relativistic theory of superstars the relativistic Rosseland mean is studied. The equation for calculating it from monochromatic absorption coefficients is shown to be free of relativistic effects. (auth)

25680 HYDRODYNAMIC BEHAVIOR OF SUPERNOVAE EXPLOSIONS. **Colgate, Stirling A.; White, Richard H. (Univ. of California, Livermore). Astrophys. J., 143: 626-81(Mar. 1966). (UCRL-7777(Rev.1)).**

The release of gravitational energy attending a dynamic change in configuration is regarded to be the primary energy source in supernova explosions. Although there is agreement with the mechanism for initiating gravitational instability proposed by Burbidge, Burbidge, Fowler, and Hoyle, it is found that the dynamical implosion is so violent that an energy many times greater than the available thermonuclear energy is released from the star's core and transferred to the star's mantle in a supernova explosion. The energy released corresponds to the change in gravitational potential of the unstable imploding core; the transfer of energy takes place by the emission and deposition of neutrinos. (auth)

25681 EXAMPLE OF GRAVITATIONAL COLLAPSE IN GENERAL RELATIVITY. **McVittie, G. C. (Univ. of Illinois Observatory, Urbana). Astrophys. J., 143: 682-8 (Mar. 1966).**

A spherically symmetric mass of gaseous material collapses onto a small central particle which is represented by a Schwarzschild-type singularity. Exact solutions of Einstein's equations are found in terms of elementary functions in which the scale-factor S occurs. S is a function of the time alone, and a differential equation for S is derived from the condition that the outer boundary of the configuration shall be a surface of zero pressure. In general, pressure and density gradients exist within the collapsing configuration. The nature of these gradients depends on the initial circumstances from which the collapse begins. The mathematically simplest case is considered in some detail, and it is shown that the temperature in the interior of the configuration can attain 10^{10}K in a comparatively short time after the start of the collapse. (auth)

25682 LOCAL IRREGULARITIES IN A GOEDEL UNIVERSE. **Silk, Joseph (Harvard Coll. Observatory, Cambridge, Mass.). Astrophys. J., 143: 689-99(Mar. 1966).**

A perturbation of the Gödel metric is considered, and a generalized Poisson equation is derived relating perturbations of potential and density. The angular velocity is evaluated in the perturbed metric. The equations of motion for an anisotropy are evaluated and simplified by reduction to a locally inertial frame of reference. The zeroth component of the equations of motion is written in integral form to give an energy equation. The uniform rotation of matter relative to the compass of inertia is shown to be locally equivalent to the appearance of a noninertial term in the Newtonian equations of motion. This result is seen to be in accord with Mach's ideas on absolute space. (auth)

25683 INVESTIGATION OF THE DYNAMICS OF OLD H II REGIONS. **Lasker, Barry M. (Princeton Univ. Observatory, N. J.). Astrophys. J., 143: 700-21(Mar. 1966).**

Models of spherical H II regions are obtained with ages up to 2×10^6 years. The shells of compressed H I are about 10 per cent of the nebular radius in thickness if radiative cooling in the compressed material is ineffective and much thinner if effective. The average radial velocities of the older models are about 4 km/sec in the H II regions and about 8 km/sec in the H I shells. Moderate magnetic fields in the initial cloud are estimated to have little effect on the over-all dynamics, and the principal effect of magnetic fields on H II regions is apparently the distortion of the initial H I cloud. The models are compared with observations; the need for further investigation in both areas is evident. (auth)

25684 HYDROGEN AND HELIUM SPECTRA OF GASEOUS NEBULAE. **Kaler, James B. (Univ. of California, Los Angeles). Astrophys. J., 143: 722-42(Mar. 1966).**

The intensities of the high members of various series of hydrogen and neutral and ionized helium are observed in some nebulae to be brighter than would be expected from recombination theory. Detailed results of a comparison between theory and observation are presented for 33 planetary nebulae and the Orion Nebula. New values for the reddening constants, electron temperatures, and electron densities were computed for the nebulae considered. (auth)

25685 LITHIUM IN GIANT STARS OF TYPES F0 TO G5. **Wallerstein, George (Univ. of California, San Diego, La Jolla). Astrophys. J., 143: 823-7(Mar. 1966).**

The ratio of lithium to calcium was derived for five F giants and six G giants. Three of the F giants show very large lithium abundances, 80–300 times the solar abundance, while none of the G giants shows an enhancement greater than a factor of 6. In the binary Capella the F star has at least 60 times the lithium content of the G star. These results are discussed in terms of the mixing of surface material during the red-giant stage. Some further observations that may shed light on evolution through the giant stage are suggested. (auth)

25686 NEW ^{13}C INDICATORS IN STELLAR SPECTRA. Wyller, Arne A. (Carnegie Inst. of Washington, D. C. California Inst. of Tech., Pasadena). Astrophys. J., 143: 828-51(Mar. 1966).

The (2,0) and (3,1) $^{13}C^{14}N$ bands of the red CN system were rotationally analyzed in the laboratory. Wavelengths are presented for a total of 437 rotational lines of which 259 pertain to the (2,0) band and 178 lines to the (3,1) band. The wavelengths are compared with the theoretically predicted values of Utsumi. A systematic difference is observed in the residuals, which arises from uncertainties in the molecular constants. If a precision of 0.1 Å is to be achieved, the theoretical calculations must be extremely accurate. Perturbations are indicated for the first few rotational levels in the R_1-branch. The laboratory wavelengths have led to a positive identification of numerous individual rotational lines of the isotopic (2,0) and (3,1) bands in the spectra of five carbon stars, which range in type from $C1_2$ to $C9_2$. The normal (2,0) band was scrutinized for regions between $^{12}C^{14}N$ line groups where only $^{13}C^{14}N$ lines fall. Twenty-five such regions were found, which may provide ^{13}C indicators, useful for surveys of the ^{13}C content in late-type stars on medium-dispersion spectra (50–100 Å/mm). Relative abundance ratios of ^{12}C to ^{13}C were derived on the basis of the observed line strengths of two cleanly isolated, single rotational lines, the isotopic $P_2(19)^1$ line at λ 8019.351 and the normal R_1 $(40)^a$ line at λ 8038.125. The derived values for the five carbon stars range from well below the equilibrium ratio (3.4 : 1) of the CNO cycle to well above it ($2:1 < a < 11:1$). The vibrational temperatures show little correlation with spectral class and are below 2400°K. The exceptionally high ^{13}C content ($a = 2:1$) in such stars as Y CVn and WZ Cas cannot be explained as a product of the equilibrium ratio of the CNO cycle. It is suggested that ^{13}C in carbon

stars is partially synthesized by spallation and processes of neutron irradiation either in the atmospheres of Wolf-Rayet stars or in the carbon stars themselves. (auth)

25687 RADIATIVE COOLING OF STELLAR MATERIAL WITH APPLICATIONS TO SOLAR FLARES. Oster, Ludwig (Boeing Scientific Research Labs., Seattle, Wash.). Astrophys. J., 143: 928-43(Mar. 1966).

Characteristic times for the cooling of stellar material by spontaneous emission for temperatures between 10^7 and $10^{4.6}$K, and for gas pressures corresponding to log $P_g = -2$ to +4 or, alternatively, electron densities between 10^8 and 10^{14} cm^{-3} are derived. These data are used to predict the time development of an element undergoing a cooling process. The numerical calculations are carried out for equilibrium conditions and continuous emission in an optically thin layer. However, the influences of departures from equilibrium, of line emission, and of finite optical thickness are estimated. The results are applied to a theoretical analysis of relevant flare observations. It is, in particular, shown that on the basis of the above arguments alone a position of the initial flare event in photospheric layers cannot be excluded. (auth)

25688 THERMAL DISSIPATION AND ITS APPLICATION TO FLARE PHENOMENA. Oster, Ludwig; Sofia, Sabatino (Yale Univ. Observatory, New Haven). Astrophys. J., 143: 944-8(Mar. 1966).

Cooling of stellar material by thermal conduction under conditions representative of the solar atmosphere is considered in the absence and in the presence of magnetic fields. The analysis, when applied to a standard flare model, shows that thermal dissipation does not lead to reasonable lifetime estimates for the flare. Thus, if shock formation and similar instabilities are neglected, radiative cooling should be the dominant mechanism. Then, however, the "temperature" of the flare material cannot greatly exceed $10^{5.9}$K, unless the flare event occurs in photospheric layers or even below. (auth)

25689 TIME DILATION OF LUMINOSITY FLUCTUATIONS OF MASSIVE OBJECTS. Noerdlinger, Peter D. (Univ. of Chicago). Astrophys. J., 143: 1004(Mar. 1966).

It is pointed out that the appropriate time interval to consider for the time dilation of luminosity fluctuations of massive objects is $T/(1 + z)$ where $1 + z$ is the redshift rather than T. Thus the maximum size is estimated by $cT/(1 + z)$ rather than cT, where c is the velocity of light. These conditions lead to reducing the upper limit on the size of massive stellar objects. The more distant of these objects should appear to fluctuate more slowly if they are uniformly distributed. (J.F.P.)

25690 DECAY TIME OF SUNSPOT MAGNETIC FIELDS. Kopecky, M.; Kuklin, G. V. (Astronomical Inst., Czechoslovak Academy of Sciences, Ondrejov). Bull. Astron. Inst. Czech., 17: 45-57(1966).

Some formulas for the calculation of the electric conductivity of the solar plasma are discussed. It is proved that the influence of both positive and negative hydrogen ions can be neglected. The electric conductivity, the anisotropy coefficients, and the decay time are calculated for some sunspot models of different areas. The effective optical depth corresponding to the observed decay time is estimated for some sunspot models. (D.C.W.)

25691 THEORETICAL ASPECTS OF SUNSPOTS. Bumba, V.; Kopecky, M.; Kuklin, G. V. (Astronomical Inst., Czechoslovak Academy of Sciences, Ondrejov). Bull. Astron. Inst. Czech., 17: 57-64(1966).

Some observational and theoretical aspects of the dynamics of the evolution of the basic elements in the fine structure of sunspots in various stages of their organization and evolution and their relation to the magnetic field structure are discussed. The insufficiency of high-resolution observational data and the need for magnetic field configuration and stability studies are emphasized. (auth)

25692 PROPERTIES OF CORPUSCULAR STREAMS EJECTED BY CHROMOSPHERIC FLARES. Fritzova-Svestkova, L. (Astronomical Inst., Czechoslovak Academy of Sciences, Ondrejov). Bull. Astron. Inst. Czech., 17: 64-7(1966).

From the position distribution of great chromospheric flares which are followed by strong geomagnetic storms, some conclusions were drawn as to the density distribution and the trail curvature of the corpuscular streams ejected by flares and causing geomagnetic storms. The densest parts of the streams are ejected from flares into a space angle of diameter $\leqq 40°$, and the whole stream is curved during its flight through interplanetary space by about 7.5° to the east. (auth)

25693 PREDICTION OF PROTON FLARE OCCURRENCE IN 1966–1968. Svestka, Z. (Astronomical Inst., Czechoslovak Academy of Sciences, Ondrejov). Bull. Astron. Inst. Czech., 17: 95-6(1966).

The occurrence of proton flares causing strong PCA events during three solar cycles was studied. A graph was obtained by which the number of proton flares producing strong PCA events can be predicted for the years 1966–1968, assuming that the cycle of solar activity will not differ substantially from the preceding three cycles. (D.C.W.)

25694 THE CONFRONTATION OF THE LOUIS DE BROGLIE PHOTON AGING THEORY WITH OBSERVATION DATA. Gerasim, Aurel (Musee Brukenthal, Sibiu, Rumania). Cah. Phys., 19: 353-8(Sept. 1965). (In Rumanian).

It is shown that by adopting the interpretation of the universal red shift that Louis De Broglie has elaborated on the basis of the double solution theory one to lead to a relation between bolometric magnitude m_{bol} and the shift $z = \Delta\lambda/\lambda_0$ which seems to agree satisfactorily with the relation $[z, m_{bol}]$ resulting from observation data. The difficulties caused by the appearance of the gravitational paradox and the affirmation that light does not undergo the Hubble effect in the local pile do not seem to be insurmountable. (tr-auth)

25695 DISTRIBUTION OF RARE GASES IN THE PYROXENE AND FELDSPAR OF THE KHOR TEMIKI METEORITE. Eberhardt, P.; Geiss, J.; Groegler, N. (Univ. of Bern). Earth Planet. Sci. Lett., 1: 7-12(Jan. 1966).

From the matrix of the Khor Temiki aubrite three grain size fractions (2.9 μ, 6.2 μ, 11.1 μ) highly enriched in feldspar and three corresponding pyroxene grain size fractions were prepared. The concentrations and isotopic compositions of He, Ne and Ar were measured in these six fractions. Diffusion loss of radiogenic, spallation and trapped rare gases in the feldspar is evident. The pyroxene shows no diffusion loss of spallation produced isotopes, even in micron sized grains. In feldspar $^{38}Ar_{spall}$ is not lost; up to 50% of the $^{21}Ne_{spall}$ may have been lost; and virtually no $^{3}He_{spall}$ is retained. ^{40}Ar is partially lost in the finest (2.9 μ) feldspar fraction. The trapped gases in the pyroxene show again a strong anticorrelation with the grain size. The feldspar contains less than 10% as much trapped ^{4}He as the corresponding pyroxene, approximately 30% trapped ^{20}Ne and between 60 to 80% trapped ^{36}Ar. (auth)

25696 PRIMORDIAL HELIUM DETECTION BY MICROPROBE TECHNIQUE. Zaehringer, J. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Earth Planet. Sci. Lett., 1: 20-2(Jan. 1966).

An investigation was made using a new microprobe technique on Fayetteville chondrite and Kapoeta howadite specimens to determine whether helium is located only in outer surfaces or also in inner grain boundaries. Scanned diagrams show that about 40% of the He peaks appear when the electron beam hits inner portions of single grains. Other observations are reported, which together indicate that inner layers might consist of boundaries between different and similar mineralogical phases. (L.B.S.)

25697 DISTRIBUTION OF SPALLATION-PRODUCED CHROMIUM BETWEEN ALLOYS IN IRON METEORITES. Shima, Masako; Honda, Masatake (Tokyo Univ.). Earth Planet. Sci. Lett., 1: 65-74(Mar. 1966).

Chromium nuclides produced by cosmic rays were measured mass spectrometrically in iron meteorites. A surface ionization method was applied with chromium, finally isolated from the samples by a solvent extraction method. A marked enrichment due to cosmic ray products of ^{54}Cr and ^{53}Cr could be observed in the samples obtained by fractional dissolution with dilute sulfuric acid. The acid dissolved a bulk of meteorite selectively, leaving a small residue of a nickel-rich metal phase which contained relatively high concentrations of natural chromium. An isotopic dilution analysis using enriched ^{50}Cr or ^{52}Cr was made to obtain absolute contents of those nuclides. In the cases of Grant and other meteorites, the nickel rich (taenite rich) fraction was found to contain a higher concentration of these products than in the nickel poor (kamacite rich) fraction which is readily soluble in acid. The over-all contents of ^{54}Cr were found to be in the range of 13–25 ppb in several meteorites, and the ratios of the products, $^{50}Cr : {}^{53}Cr : {}^{54}Cr$ were always found to be approximately 0.2 : 1 : 1 respectively. The enrichment of these chromium nuclides in taenite was confirmed by several methods. The interpretation of this phenomenon is discussed from a cosmochemical viewpoint. (auth)

25698 HELIUM BURNING PRODUCTS IN GIANT STARS. Duorah, H. L. (Gauhati Univ., India). Indian J. Pure Appl. Phys., 4: 128-9(Mar. 1966).

The abundances of ^{12}C, ^{16}O, and ^{20}Ne in the giant phase of stellar evolution are calculated, employing the reaction rates reported recently by Fowler and Hoyle. The earlier results of Duorah and Kushwaha seem to be in better conformity with the observed values in supergiant stars of ≥ 10 solar masses than are those obtained in the present investigation. It is suggested that a re-investigation of the rate parameters is necessary to decide which set of results is more realistic. (auth)

25699 CHANGE OF RELATIVISTIC COLLAPSE INTO ANTICOLLAPSE AND KINEMATICS OF A CHARGED SPHERE. Novikov, I. D. (Steklov Mathematics Inst., Academy of Sciences, USSR). JETP Lett. (USSR)(Engl. Transl.), 3: 142-4(Mar. 1, 1966).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Redakt., 3: 223-7(Mar. 1, 1966).

It is shown that the expansion of a star after contraction can occur and that the star goes out from under the Schwarzschild sphere but into another external region which is Euclidean at infinity with the same properties as the first external region and situated in the absolute future relative to it. For this purpose the collapse of a sphere of charged dust is considered. It is assumed that the matter in this sphere is originally rarefied and that it has a uniform charge distribution which does not become redistributed in the matter during the course of the collapse. (J.F.P.)

25700 ESCAPE OF PHOTONS FROM GRAVITATIONALLY INTENSE STARS. Synge, J. L. (Dublin Inst. for Advanced Studies). Mon. Notic. Roy. Astron. Soc., 131: 463-6(1966).

A star of mass m and Schwarzschild radius r_0 is called gravitationally intense if the ratio $2m/r_0$ is only slightly less than unity. It is shown that, if photons are emitted in all directions from a point on the surface of a gravitationally intense star, only those emitted in directions lying within a slender critical cone escape to infinity; photons emitted in directions outside that cone are recaptured by the star. In the limit as $2m/r_0$ tends to unity, the critical cone degenerates into a line normal to the surface of the star. Since light rays are reversible, it follows that in this limit not only do all escaping photons issue in directions perpendicular to the surface, but also all photons reaching the star from infinity fall perpendicularly on its surface. (auth)

25701 GRAVITATIONAL INSTABILITY IN A MAGNETIC MEDIUM. Strittmatter, P. A. (Princeton Univ. Observatory, N. J.). Mon. Notic. Roy. Astron. Soc., 131: 491-8(1966).

Certain aspects of the first order stability analysis of an infinite uniform medium pervaded by a magnetic field are re-examined, in particular, the conclusion that the Jeans stability criterion remains unaffected by the magnetic field except for those modes propagated perpendicular to the lines of force. The nature of the unstable modes is investigated, and their cosmogonical importance assessed. The results are compared with those obtained from the virial theorem and the applicability to problems of cloud formation of the two approaches is discussed. The minimum mass M_c below which a cloud is unable to contract across the field is given by $M_c = \rho\lambda_H{}^3$ (ρ = density, λ_H = magnetic Jeans length); a cloud of mass $M = \rho\lambda_J{}^3$ (λ_J = Jeans length) will not in general be able to contract indefinitely in the presence of a magnetic field. (auth)

25702 M DWARF FLARE STARS. Vardya, M. S. (Joint Inst. for Lab. Astrophysics, Boulder, Colo.). Mon. Notic. Roy. Astron. Soc., 131: 521-3(1966).

Acoustic waves, hydromagnetic effect, and convective instability due to molecular dissociation are considered as mechanisms for flare activity in M dwarf stars. The first mechanism does not appear to be significant. The last two mechanisms appear to be important, though no definite conclusions can be stated of their exact roles due to the approximate nature of convective theories and hydromagnetic models. (auth)

25703 ABUNDANCE ANALYSIS OF THE PECULIAR STAR HD 101065. Przybylski, A. (Australian National Univ., Canberra). Nature, 210: 20-2(Apr. 2, 1966).

An analysis was made of the spectra of the HD 101065 star in the visual range. The abundance analysis was carried out on only 350 lines of fifteen elements using curve of growth diagrams. The results are tabulated along with the over- or under-abundance of elements in comparison with Suess and Urey's cosmic abundances. (L.B.S.)

25704 GENERAL RELATIVISTIC INSTABILITY OF SUPERMASSIVE STARS. Sato, Humitaka (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), 35: 241-60(Feb. 1966).

The instability criterion for a star without rotation is derived by the method of variation, in the post-Newtonian approximation, and proved to coincide with the results of Chandrasekhar. To apply this criterion to the supermassive stars, the adiabatic exponent in the case of electron pair creation was calculated, and the following results obtained: The instability results from the general relativistic effect for stars of $M > 3.5(10)^4$ solar masses and from electron pair creation for $M < 3.5(10)^4$ solar masses. The applicability of the treatments is limited to 10^9 solar mass $> M > 10^3$ solar mass. The upper limit results from the fact that a star above this limit cannot be in quasi-static equilibrium but must be in free-fall contraction, and the lower limit results from the assumption about the structure, which takes a simple polytrope of index 3. (auth)

25705 QUASISTELLAR OBJECTS AND SEYFERT GALAXIES. Shklovskii, I. S. (Shternberg Astronomical Inst. USSR). Soviet Astron. AJ (Engl. Transl.), 9: 683-9 (Mar.-Apr. 1966).

Translated from Astron. Zh., 42: 893-901(Sept.-Oct. 1965).

The source 3C273 emits submillimeter and far-infrared synchrotron radiation at an intensity of $\approx 3 \times 10^{47}$ erg/sec, probably limited to an optical region measuring $< 4 \times 10^{16}$ cm. Under these conditions the optical radiation is readily explained as an inverse Compton effect for submillimeter quanta on relativistic electrons of energy ≈ 10 Mev. In NGC 1275 the source of centimeter radiation has a linear size $r \approx 0.1$ pc. The "flat" spectrum probably extends into the submillimeter and far-infrared range. The total intensity of the synchrotron radiation may exceed 10^{44} erg/sec. Its basic properties characterize this object as an "invisible quasar." Because of the inverse Compton effect, an invisible quasar will be a strong source of hard photon radiation, which ionizes the dense gas clouds in the nucleus of NGC 1275. The nuclei of other Seyfert galaxies should contain somewhat similar invisible quasars; they might be observable at the highest radio frequencies. There is no qualita-

tive difference between Seyfert galaxies and quasistellar objects. The latter apparently represent an active phase in the evolution of radio galaxies, while most Seyfert galaxies are normal systems with nuclei in the active phase. Nucleus activity is a recurrent phenomenon. A search should be made for variability in the centimeter radiation of NGC 1275. It may soon be possible to detect infrared and x radiation from the nuclei of Seyfert galaxies. (auth)

25706 THE TEMPERATURE OF INTERGALACTIC GAS. Ginzburg, V. L.; Ozernoi, L. M. (Lebedev Physics Inst., Moscow). Soviet Astron. AJ (Engl. Transl.), 9: 726-37(Mar.-Apr. 1966).

Translated from Astron. Zh., 42: 943-58(Sept.-Oct. 1965).

The kinetic temperature of intergalactic gas is considered in an evolving cosmological model. Various heating and cooling mechanisms are discussed. Explosions of galaxies and radio galaxies are highly efficient heat sources. Heat is released through energy dissipation of the plasma oscillations excited by anisotropic cosmic-ray streams. Ionization losses by relic subcosmic rays in the intergalactic gas can also generate heat. Solutions to the thermal-balance equation yield the intergalactic-gas temperature as a function of metagalactic expansion. A lower bound on the gas temperature is $10^{5°}$K at the present epoch; thus the prevailing opinion that evolutionary cosmology requires a low gas temperature is incorrect. An analysis of the gas temperature in clusters of galaxies yields the time dependence of the temperature, beginning when the gravitational condensation of cluster galaxies is completed, or a member radio galaxy explodes. A range of values is admitted for the cluster parameters. Several opportunities are discussed for deriving the intergalactic-gas temperature observationally and refining the associated theoretical considerations. (auth)

25707 THE GRAVITATIONAL FIELD OF ROTATING SUPERDENSE CONFIGURATIONS. Gurovich, V. Ts. Soviet Astron. AJ (Engl. Transl.), 9: 750-1(Mar.-Apr. 1966).

Translated from Astron. Zh., 42: 974-6(Sept.-Oct. 1965).

Perturbation theory is applied to the Einstein space for the determination of the metric of a slowly-rotating large mass, in the absence of rotation the metric reducing to Schwarzschild's metric. The component of the metric tensor depending on rotation is the same as that of a slowly-rotating small mass. The solution is of interest in the consideration of the collapse of a rotating mass and the motion of particles in the field of a rotating superdense configuration. (auth)

25708 ACCELERATION OF CHARGED PARTICLES BY BREMSSTRAHLUNG QUANTA. Rumyantsev, A. A. (Kalinin Polytechnic Inst., Leningrad). Soviet Astron. AJ (Engl. Transl.), 9: 756-9(Mar.-Apr. 1966).

Translated from Astron. Zh., 42: 981-5(Sept.-Oct. 1965).

Charged particles may be accelerated through the absorption of a flux of bremsstrahlung photons by electrons. There exists a natural radiation (in supernova outbursts) intense enough to give nuclei an energy comparable to their rest energy. (auth)

25709 CORONAL EMISSION LINE INTENSITY AS AN INDEX OF SOLAR CORPUSCULAR RADIATION. Gnevyshev, M. N.; Ol', A. I. (Main Astronomical Observatory, Academy of Sciences, Kislovodsk, USSR). Soviet Astron. AJ (Engl. Transl.), 9: 765-7(Mar.-Apr. 1966).

Translated from Astron. Zh., 42: 992-5(Sept.-Oct. 1965).

It is demonstrated that the mean annual values of geomagnetic disturbance (A_p) are related to the intensity of the coronal line λ 5303 Å more closely than to any other index of solar activity. The conclusion is drawn, therefore, that coronal intensity can be used as an index of solar corpuscular radiation. (auth)

25710 INFLUENCE OF THE MEDIUM ON GENERATION OF TYPE-IV SOLAR RADIO EMISSION. Zheleznyakov, V. V.; Trakhtengerts, V. Yu. (Gor'kii State Univ., USSR). Soviet Astron. AJ (Engl. Transl.), 9: 775-9(Mar.-Apr. 1966).

Translated from Astron. Zh., 42: 1005-10(Sept.-Oct. 1965).

The characteristics of synchrotron radiation of a relativistic electron in plasma are considered. It is shown that the influence of plasma on synchrotron radiation becomes particularly important when the parameter $\delta \equiv \sqrt{3}\,(\omega_L/\omega_H)\,(mc^2/\epsilon) \gg 1$ (ω_L is the Langmuir frequency, ω_H is the gyrofrequency, mc^2 is the rest energy of the electron, ϵ is electron energy). The maximum of the radiation frequency spectrum in this case is displaced in the direction of the high frequencies, but the spectral and total intensity of radiation become exponentially small ($\sim e^{-\delta}$). On the basis of the results conclusions are drawn concerning conditions in the region of generation of type-IV radio emission. In particular, as a result of a sharp attenuation of radiation when $\delta \gg 1$ in most observed type-IV sources, there must be relations between the energies of the particles, plasma concentration and the magnetic field strength at which $\delta \gtrsim 1$. (auth)

25711 RELATIONSHIP BETWEEN SPORADIC SOLAR RADIO EMISSION IN THE DECAMETER RANGE AND CHROMOSPHERIC FLARES. Artem'eva, G. M.; Benediktov, E. A.; Rapoport, V. O. (Gor'kii State Univ., USSR). Soviet Astron. AJ (Engl. Transl.), 9: 780-1(Mar.-Apr. 1966).

Translated from Astron. Zh., 42: 1011-13(Sept.-Oct. 1965).

A comparison of data on bursts of solar radio emission in the decameter range with the parameters of chromospheric flares reveal the presence of a relation between the probability of appearance of a burst and the width of the H_α line at the time of the flare. It also was found that there is east-west asymmetry of distribution of radio emission bursts in the decameter range on the solar disk. (auth)

25712 THE INITIAL PHASE OF DEVELOPMENT OF A CHROMOSPHERIC FLARE. Obashev, S. O. (Astrophysics Inst., Academy of Sciences, Kazakh SSR). Soviet Astron. AJ (Engl. Transl.), 9: 784-7(Mar.-Apr. 1966).

Translated from Astron. Zh., 42: 1017-21(Sept.-Oct. 1965).

The theory of a point explosion in a nonhomogeneous atmosphere is applied to a chromospheric flare. The flare energy estimated from the duration of the flash stage is $\sim 3 \cdot 10^{25}$ ergs. The time variation of the flare area is obtained. The general nature of the curve of this variation is in agreement with that observed. (auth)

25713 MEASUREMENTS OF ERUPTIVE PHENOMENA ON THE SOLAR LIMB. Chang, Ho-ch'i; Ts'ao, T'ien-chun. Tien Wen Hsueh Pao, 12: 138-54(1964).

From a large number of H_α photographs of limb flares, fifteen were selected for reduction. The films were obtained with the standard patrol telescope during the years 1959–1960. From the photometric and positional measurements of limb flares it was concluded that: There are violent radial ejections of matter during the flash-phase of the flare. Usually a part of the flare is ejected to distances ranging from 2×10^4 to 2.5×10^5 km above the base of the chromosphere. The mean velocity of ejection is of the order of 30 km/sec–400 km/sec. The maximum velocity appears in the initial stage of ejection and decreases later on. The acceleration of ejection is supergravitational. The ejective motions of flares are regular and apparently connected with the magnetic fields of the active regions. During the flash phase of the flare the velocity of ejection varies directly with the rate of increase of brightness. It was also noted that the appearance of radio events is closely related to the ejection. (ATD)

25714 ASSOCIATION RATE BETWEEN FLARES AND TYPE II BURSTS. Drago, F. G.; Tagliaferri, G. L. (Osservatorio Astrofisico di Arcetri, Florence). Z. Astrophys., 63: 202-6(1966).

The association probability "flares—type II bursts" is investigated taking into account the occurrence of the flare on the N-resp. S-hemisphere and the phase in the

solar cycle. No asymmetry between North- and South-flares in producing type II bursts is found. On the contrary the association percentage clearly increases from the maximum towards the minimum of solar activity. This effect particularly evident for the subflares, is interpreted as a consequence of the shift of the critical levels through the corona caused by the variation of electron density with the solar cycle. The behavior of the critical level for a given frequency approaching the limb during the declining phase of the solar cycle resembles that of the association percentage subflares-type II bursts. (auth)

25715 NUCLEAR FISSION IN THE EARLY HISTORY OF THE SOLAR SYSTEM AND XENON ISOTOPES IN THE EARTH'S ATMOSPHERE. Kuroda, P. K. (Univ. of Arkansas, Fayetteville). pp 365-72 of Recent Researches in the Fields of Hydrosphere, Atmosphere and Nuclear Geochemistry. Miyake, Yasuo; Koyama, Tadashiro (eds.). Nagoya, Japan, Sugawara Volume, Nagoya Univ., 1964.

The isotopic compositions of atmospheric xenon and xenon extracted from the Fayetteville meteorite and from the Besner Mine thucholite were compared. The atmospheric xenon was "heavier" than the meteoritic xenon. The data indicated that the Earth's atmosphere contains an excess of fission xenon, which is the product of the spontaneous fission of ^{244}Pu. The time interval between the nucleosynthesis and formation of the Earth was calculated to be 55 to 270 million years. (auth)

Atomic Physics

Refer also to abstracts 25847 and 26187.

25716 (AD-631601) TABLE OF HARTREE-FOCK SELF-CONSISTENT FIELD WAVE FUNCTIONS WITH EXCHANGE. Supplement II. Chapman, Robert D.; Clarke, William H. (California Univ., Los Angeles). Jan. 1966. 444p. (ARL-66-0018). CFSTI $7.44 cy, $2.00 mn.

A table of Hartree-Fock self consistent field wave functions with exchange is presented for ions of the isoelectronic sequence Na(I), ..., Si(IV). The configurations considered are 3s, 3p, 3d, 4s, ..., 4f, 5s, ..., 5g, 6s, ..., 6h, 7s. (auth)

25717 (BNL-946) NEUTRONS AS MAGNETIC PROBES. Brookhaven Lecture Series No. 49. Nathans, Robert (Brookhaven National Lab., Upton, N. Y.). Sept. 29, 1965. Contract AT(30-2)-Gen-16. 18p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

The usefulness of the neutron for investigating the structure of magnetic materials is discussed. The use of neutrons for determining the magnetic structure of manganese fluorides is described. (M.O.W.)

25718 (CEA-R-2912) PROFILS THEORIQUES DES RAIES SPECTRALES DE L'ATOME D'HYDROGENE. (Theoretical Profiles of the Spectral Lines of the Hydrogen Atom). Nguyen-Hoe; Drawin, Hans-Werner; Herman, Louis (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Dec. 1965. 42p. (EUR-2630.f). Dep. mn.

The line-broadening problem of the hydrogen lines was formulated in the quasistatic approximation as far as the ions are concerned, and in the classical path approximation as far as the broadening due to collisions with electrons is concerned. These electrons interfere in different numerical results only by the self-correlation function of the fluctuating electrical field strength created at each point in the plasma. The Lewis correction was applied, but using the whole velocity distribution function of the electrons. The formula which represents the usual impact profile, valid only for frequencies much smaller than the plasma frequency, was extended using another formula which will be valid up to the neighborhood of that spectral region where the quasi-static approximation begins to be valid also for the electrons. As an example, the line profile of Ly α is given by some graphs for $T = 10^{4\circ}K$ and electron densities $N = 10^{17}$ cm^{-3} and $N = 10^{18}$ cm^{-3}. (auth)

25719 (CEA-R-2913) DEPLACEMENT ET INTENSITE DES COMPOSANTES DES RAIES DE L'ATOME D'HYDROGENE SOUMIS A UN CHAMP ELECTRIQUE ET UN CHAMP MAGNETIQUE EXTERIEUR UNIFORMES. (Displacement and Intensity of the Components of the Lines of the Hydrogen Atom Subjected to Constant External Electrical and Magnetic Fields). Herman, Louis; Nguyen, Hoe; Drawin, Hans-Werner; Petropoulos, Basile; Deutsch, Claude (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Dec. 1965. 54p. (EUR-2604.f). Dep. mn.

The wave equation for the hydrogen atom, perturbed by external constant electric and magnetic fields, was solved using the perturbation method, for an arbitrary angle between the two fields. The numerical solution was carried-out on an electronic computer. The obtained results were tested using closed form expressions for particular cases, and also using "total intensity conservation rules." The most conspicuous features of the deplacement and the intensity changes of the components of the H_α line, as a function of the field parameter A and the cosine of the angle between the two perturbing fields, are illustrated by some figures and a set of tables. (auth)

25720 (IPP-1/47) ELECTRON IMPACT IONIZATION CROSS SECTIONS AND IONIZATION RATE COEFFICIENTS FOR ATOMS AND IONS. Lotz, Wolfgang (Institut fuer Plasmaphysik, G.m.b.H., Garching (West Germany)). Apr. 1966. 55p. Dep. mn.

All available experimental data on cross sections for single ionization of atoms and ions from the ground state by electron impact in the low energy range (≤10 kev) were collected. For each species a best fit curve was drawn. The experimental results can be approximated by the following formulas: $\sigma = \xi_1 [a \ln (E/\chi)/\chi \cdot E]$ [cm^2], if $\chi \leq E \leq \chi'$, $\sigma = \xi_1 [a \ln (E/\chi)/\chi \cdot E] + \xi_2 [a \ln (E/\chi')/\chi' \cdot E] = \xi_3 [a \ln (E/\overline{\chi})/\overline{\chi} \cdot E]$, if $E \geq \chi'$, where χ is the ionization potential for electrons in the outermost shell in ev, χ' is the ionization potential for electrons in the next inner (sub)-shell, $\overline{\chi}$ is a weighted mean of χ and χ', E is the electron energy in ev, $a = 3.6 \times 10^{-14}$ for atoms, $a = 4.0 \times 10^{-14}$ for ions. $\xi \geq 0.5$ is a slowly varying function and asymptotically equal to the number of equivalent electrons. By comparison of isoelectronic species as well as of equally charged species it is possible to make predictions for yet unknown cross sections. Ionization rate coefficients for all species in the triangle H(I)–Na(I)–Na(XI) are given with an estimated error of $^{+40}_{-30}$ %. (auth)

25721 (LA-3475) PRESENT STATUS OF THE ANALYSIS OF THE ARC SPECTRUM OF URANIUM (UI). Steinhaus, David W.; Blaise, Jean; Diringer, Michele (Los Alamos Scientific Lab., Univ. of California, N. Mex.). Jan. 1966. Contract W-7405-eng-36. 184p. Dep. mn. CFSTI $5.00 cy, $1.00 mn.

The calculated rectangular array and line list (6121 lines) of UI are presented for all allowed lines from the known levels (35 odd, 394 even). Experimental wave number values are given for 3376 of these lines, and experimental isotope shift ($^{235}U-^{238}U$) values for 1530 of them. Although the upper and lower levels for many strong lines are certain, the description and analysis of this spectrum are far from complete. Wave number measurements exist for only about 10% of the estimated number of lines measurable with modern high resolution apparatus. (auth)

25722 (NP-15967) BIBLIOGRAPHY ON ATOMIC TRANSITION PROBABILITIES. Glennon, B. M.; Wiese, W. L. (National Bureau of Standards, Washington, D. C.). Apr. 22, 1966. 94p. (NBS-Misc.-Publ.-278). GPO $0.55.

Supersedes Monograph 50.

A revised and updated bibliography on atomic transition probabilities is presented. The papers are arranged according to elements and stages of ionization, and the method employed and class of transitions are indicated behind each reference. Only articles on discrete transitions, both permitted and forbidden, are listed. Also included is a supplementary list of important papers dealing with transition probabilities from a general point of view, and a table of comprehensive papers not included in the element list. (auth)

25723 (RT-FI-(65)-60) ELASTIC CROSS SECTIONS OF LOW-ENERGY ELECTRONS IN RARE GASES. Braglia, G. L.; de'Munari, G. M.; Mambriani, G. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Dec. 1965. 14p. Dep. mn.

Elastic total cross sections and momentum transfer cross sections of electrons in helium, neon, argon, krypton and xenon, are reported as functions of the electron energy from 10^{-3} ev up to first-excitation energy of each type of atom. The said cross sections were obtained from several data given in literature. The chosen cross sections are reported both in numerical and in graphical form. The numerical values, written with three figures, are given for convenience of anyone who has to perform numerical calculations. The graphs are drawn so as to give an indication of the accuracy of the numerical data. (auth)

25724 (ORNL-tr-1144) TOTAL ABSORPTION AS A MEASURE OF THE NUMBER OF DISPERSION ELECTRONS. Schuetz, Wilhelm. Translated for Oak Ridge National Lab., Tenn., from Z. Astrophys., 1: 300-13 (1930). 19p. Dep. mn. JCL $1.60 fs, $0.80 mf.

It is shown that the "total absorption" of a spectroscopically unresolved absorption line is proportional to the root of the number of atoms in the absorbing vapor layer under suitable experimental conditions. However, if the number is sufficiently small, then the law of roots which was explained in theory by Ladenburg and Reiche no longer applies and the total absorption proves to be approximately independent of the number. This behavior is attributed in a more general connection to the influence of the Doppler effect and is given a theoretical explanation. A survey is presented of the absorption methods with special consideration of their fundamentals, their effectiveness, and their applicability. (auth)

25725 (ORNL-tr-1180) INTENSITY AND NATURAL WIDTH OF 'E BLUE CESIUM DOUBLET. [PART] I. Schuetz, Wilhelm. Translated for Oak Ridge National Lab., Tenn., from Z. Phys., 64: 682-96(1930). 19p. Dep. mn. JCL $1.60 fs, $0.80 mf.

The total absorption is determined graphically and mathematically with consideration of the Doppler effect as a function of the number of dispersion electrons on the path of the light beam. The newly determined transition range between the ranges of validity of the two limiting laws cited by Ladenberg and Reiche for very weak and strong absorption is particularly remarkable. In this transition region, the total absorption is practically independent of the number of dispersion electrons. The method of determining the ratio of the dispersion electrons responsible for the blue doublet from the total absorption in pure cesium vapor has proved to be unsuitable. A lower limit value of 3.6 is presumably obtained from the magnetic rotation, which can be considered as a preliminary result. The combination of the total absorption with the number of dispersion electrons determined from magnetic rotation results in the value $\omega_0' = 2.5 \cdot 10^7$ sec = 0.24 ω'_{class} for the natural width of the lines. Due to the uncertainty of the reported numerical values resulting from the hyperfine structure, the investigation is being continued. (auth)

25726 ELECTRON GROUPS IN THE THOMAS-FERMI ATOM ACCORDING TO THE RADIAL QUANTUM NUMBER. Konya, A. (Research Group for Theoretical Physics, Budapest). Acta Phys. Acad. Sci. Hung., 20: 361-9(1966).

A method is given for the decomposition of the electron cloud in the Thomas-Fermi atom into electron groups which correspond to the groups of electrons with equal radial quantum numbers in the wave mechanical atom. The number of electrons with given values of the radial quantum number is calculated numerically as function of the atomic number. The results agree quite well with those of wave mechanics. (auth)

25727 DISPERSION RELATION FOR THE CAUSAL TRANSFORM AND ITS CORRESPONDENCE WITH A ONE DIMENSIONAL DYNAMICAL SYSTEM. Biswas, P. K. (Dept. of Theoretical Physics, Jadavpur, Calcutta). Acta Phys. Acad. Sci. Hung., 20: 371-3(1966).

The mapping of causal transforms, whose real and imaginary parts are Hilbert transforms of each other, on to a set of families of trajectories defined by the partial differential equations of Hamilton's canonical form is considered, which yields the correspondence with a set of one-dimensional dynamical systems. (L.B.S.)

25728 STATISTICAL TREATMENT OF MANY-BODY SYSTEMS UNDER CONSIDERATION OF THE CENTRIFUGAL POTENTIAL. Rennert, P. (Inst. of Theoretical Physics, Dresden). Acta Phys. Acad. Sci. Hung., 20: 375-8(1966).

A method is developed for the statistical treatment of many-body systems such as electrons in atomic shells, which contains completely the centrifugal potential. Expressions are derived for calculating the radial density distribution for any potential V(r). The results are applied to the Coulomb potential, and are compared with the Hartree solution, the Thomas-Fermi approximation, and other calculations. (L.B.S.)

25729 JUSTIFICATION OF THE ONE-BODY MODEL FOR AN ELECTRON OUTSIDE A "CORE" WITH APPLICATIONS TO LITHIUM AND SODIUM. Oehrn, Yngve (Univ. of Uppsala); McWeeny, Roy. Ark. Fys., 32: 461-70 (1966).

The possibility is investigated of formulating a one-body eigenvalue equation for an electron outside a closed shell with no constraints on the orbital of strong orthogonality towards the core function. (auth)

25730 CORRELATED WAVE FUNCTIONS FOR THREE-ELECTRON IONS. Oehrn, Yngve; Nordling, Jan (Univ. of Uppsala). Ark. Fys., 31: 471-8(1966).

A scheme for automatic calculation of correlated wave functions and total non-relativistic energies for the three electron ions is developed and applied to the three lowest ns ^{2}S-terms of the lithium atom. In addition ground state energies and wave functions are calculated for Be^+, B^{2+}, C^{3+}, N^{4+} and O^{5+}. (auth)

25731 THE WAVELENGTHS OF THE LYMAN LINES OF Be IV THROUGH Si XIV. Edlen, Bengt. Ark. Fys., 31: 509-10(1966).

Revised values for the calculated wavelengths of the transitions 1s−np are tabulated for the one-electron spectra Be IV through Si XIV. (auth)

25732 VARIATIONAL METHOD AND THE ELASTIC SCATTERING OF SLOW ELECTRONS BY HYDROGEN ATOM. Banerjee, Satyanarayan; Jha, Rameshwar; Sil, N. C. (Indian Association for the Cultivation of Science, Calcutta). Indian J. Phys., 39: 455-63(Oct. 1965).

The elastic scattering of slow electrons by the hydrogen atom is investigated using the variational method of Hulthen in the energy range below the threshold for the excitation of the second quantum level (10.2 ev) of atomic hydrogen. Polarization is accounted for in the wave function which includes a term indicating virtual excitation to 2s and $2p_0$ levels. This leads to the occurrence of a pronounced resonance at 9.74 ev, which agrees with previous theoretical results as well as with recent experiments. (G.O.Y.)

25733 LOW ENERGY SCATTERING OF ELECTRON BY HELIUM ATOM BY THE VARIATIONAL METHOD. Banerjee, Satya Narayan; Jha, Rameshwar; Sil, N. C. (Indian Association for the Cultivation of Science, Calcutta). Indian J. Phys., 39: 552-3(Nov. 1965).

The elastic scattering cross section of electrons by helium is investigated for low energy of the incident electron such that only S-wave phase shift needs to be considered. The variation method of Hulthen is applied with an open shell wave function and with a polarization term in the potential to take into account the distortion of the helium charge cloud due to the presence of the incident electron. Further the exchange effect due to the indistinguishability of the electrons is included. (L.B.S.)

25734 EXCITATION OF NITROGEN GAS BY ALPHA PARTICLES AND FISSION FRAGMENTS. Axtmann, Robert C.; Sears, John T. (Princeton Univ., N. J.). J. Chem. Phys., 44: 3279-83(May 1, 1966).

Excitation of the SPG (second positive group: $C^3\pi_u \rightarrow$

$B^3\pi_g$) by fission fragments and by 6.1-Mev alpha particles was studied with a pulse technique. Both types of particles exhibit nearly the same efficiency for excitation from which it was concluded that in either case secondary electrons are responsible for the production of the triplet states. (auth)

25735 INTERACTION OF THERMAL ELECTRONS WITH POLARIZABLE AND POLAR MOLECULES. Christophorou, L. G.; Hurst, G. S.; Hadjiantoniou, A. (Oak Ridge National Lab., Tenn.). J. Chem. Phys., 44: 3506-13(May 1, 1966). (ORNL-P-1767).

Drift velocities w were measured for thermal electron swarms traveling through gases and gas mixtures. The w data are used to calculate average cross sections for momentum transfer, σ's, which are assumed to have a v^{-1} and a v^{-2} dependence for nonpolar and polar molecules, respectively. An effort is made to correlate the experimental values of σ with the molecular polarizabilities and/or the molecular dipole moments. The theoretically predicted correlations are discussed and compared with our experiments. Simple theories of long-range forces agree reasonably well with the experimental data; the agreement between theory and experiment is better when the theory avoids the use of the Born approximation. Various factors proposed to account for the observed differences between the experimental data and the simple theory of short-range inductive forces are discussed, and the conclusion is drawn that detailed theoretical consideration must be given to each nonpolar molecule before agreement with experiments can be achieved. (auth)

25736 ENERGY TRANSFER BETWEEN RARE-EARTH IONS. Van Uitert, L. G.; Johnson, L. F. (Bell Telephone Labs., Inc., Murray Hill, N. J.). J. Chem. Phys., 44: 3514-22(May 1, 1966).

Fluorescence quenching effects caused by multipolar energy-transfer interactions between rare-earth ions are examined. Transfer between remote ions by way of transitions that are matched in energy appears to be essentially dependent upon concentration alone (e.g., Sm^{3+} self-quenching) while transfer by nonresonant mechanisms can show a strong dependence upon crystal structure (e.g., Eu^{3+} self-quenching). Examples of thermally dependent multipolar transfer interactions are also given. (auth)

25737 ELECTRON-HYDROGEN IONIZATION: THE ASYMPTOTIC FORM OF THE WAVE FUNCTION AND THE THRESHOLD BEHAVIOR OF THE CROSS SECTION. Temkin, A. (Goddard Space Flight Center, Greenbelt, Md.). Phys. Rev. Lett., 16: 835-9(May 9, 1966).

The inadequacies of the asymptotic form of the wave equation, which is a rigorous theoretical approach to the calculation of the ionization cross section of atomic hydrogen by electron impact and from which the linear threshold law of ionization was developed, are discussed. This is accomplished by means of a simple model to show that the neglecting of certain terms in deriving this asymptotic form is not justified. A new asymptotic form of the wave equation, which is more acceptable, is developed. (B.G.D.)

25738 EXPERIMENTAL STUDY OF CHARGE TRANSFER IN PROTON-ATOMIC HYDROGEN COLLISIONS AT IMPACT ENERGIES ABOVE 40 kev. Gilbody, H. B.; Ryding, G. (London Univ.). Proc. Roy Soc. (London), Ser. A, 291: 438-43(Apr. 26, 1966).

The crossed beam technique was used to study charge transfer in proton-atomic hydrogen collisions between 40 and 130 kev. A proton beam from a Van de Graaff accelerator was arranged to intersect a modulated beam of atomic hydrogen derived from a furnace source. The flux of fast neutral atoms produced by charge transfer in the beam intersection region was measured by a method based on double electrostatic deflection of the proton beam. The ratio of the charge transfer cross section Q_1 in atomic hydrogen to that in molecular hydrogen Q_2 was determined by comparing the signals when the beam from the furnace was mainly atomic and when the beam was entirely molecular. Above 50 kev, measured ratios Q_1/Q_2 were consistently less than ½. Absolute values of Q_1, which represent total cross sections for capture into all states of atomic hydrogen, were obtained by reference to known values of Q_2. Above 50 kev, the results agree fairly well with theoretical values due to Jackson & Schiff. When considered in conjunction with the low energy data of Fite and his collaborators, the results suggest that capture into excited states in the range 20 to 50 kev occurs to a greater extent than that predicted by Jackson & Schiff. (auth)

25739 EXCITATION OF HELIUM FROM THE 2^3S STATE BY ELECTRON COLLISION. Ochkur, V. I.; Bratsev, V. F. (Zhdanov Leningrad State Univ.). Soviet Astron. AJ (Engl. Transl.), 9: 797-9(Mar.-Apr. 1966).

Translated from Astron. Zh., 42: 1034-7(Sept.-Oct. 1965).

The probabilities of excitation of a series of triplet and singlet helium levels from the 2^3S metastable state by electron collision were computed in the first approximation of the perturbation theory. Data for the higher levels can be obtained by extrapolation of the tables given. (auth)

25740 MOLECULAR ROTATIONS IN GASES, RENDERED EVIDENT BY THE METHOD OF NEUTRON SCATTERING. Bally, D. Stud. Cercet. Fiz., 16: 791-7(1964).

Partial differential cross sections of methane for incident neutrons with an energy of 0.0256 ev and for a scattering angle of 16.3° were determined. Corrections for multiple neutron scattering were neglected since the studied sample had a 90% transmission factor. For measurements of the partial differential cross section a three-axes neutron spectrometer was used, with vanadium as a scatterer (elastic and isotropic) for the studied interval of the incident neutron energies. The experimental results were compared with theoretical data obtained by Griffing. It was concluded that for incident neutrons energies of less than 80 Mev, a description of the experimental data by means of relations neglecting the discrete character of molecular rotations is not accurate. (Rum. Sci. Abstr.)

25741 SECOND-ORDER STRUCTURE CORRECTIONS TO THE LAMB SHIFT IN HYDROGEN AND DEUTERIUM ATOMS. Petrun'kin, V. A.; Semenko, S. F. (Lebedev Inst. of Physics, Moscow). Yadern. Fiz., 3: 489-94(Mar. 1966). (In Russian).

Corrections to the Lamb shift $\Delta E = E_{2S_{\frac{1}{2}}} - E_{2P_{\frac{1}{2}}}$ in hydrogen and deuterium atoms, due to the polarizability of the nucleus in the field of the electron or muon (second order structure corrections), are calculated. It is shown that these corrections are smaller than the experimental errors in Lamb-shift measurements, by three orders of magnitude for hydrogen and one order for deuterium. The calculated corrections are relatively more important in hydrogen and deuterium μ-mesic atoms. The conditions are formulated, under which it is possible to use the polarization potential for the electron meson(μ^-)-nucleus interaction, to calculate the second order structure corrections. (auth)

25742 ISOTOPE SHIFT IN μ MESOATOMS. Mikulinskii, M. A.; Osadchiev, V. M. Yadern. Fiz., 3: 639-42 (Apr. 1966). (In Russian).

A relation is obtained between the volume isotope shift of electron and meson levels. The change of the mean quadratical radius is calculated for Ca and O isotopes. The results are compared with experiments. (auth)

25743 THE ANGULAR DEPENDENCE OF RESONANT SCATTERING OF LOW-ENERGY ELECTRONS ON He, Ne, Ar, AND N_2. Andrick, D.; Ehrhardt, H. (Univ., Freiburg i. B.). Z. Phys., 192: 99-106(1966). (In German).

The energy dependence of the elastic resonance scattering of low-energy electrons from He, Ne, Ar, and N_2 was measured in the angular range from 8 to 110°. From the measurements are derived the total angular momenta and hence the configurations of the quasistationary negative ion states. The line shapes depend very strongly on the phase shifts for the potential scattering and on the interference of different partial waves. In the cases of He and Ne, phase shifts are determined. The resonance structure in the

elastic scattering from N_2 in the energy range from 1.75 to about 3.5 ev seems to be due to the formation of the N_2^- ion in its electronic ground state with a $^2\Pi$ configuration. The separations of its first few vibrational states are 237 ± 10 Mev, the natural half-width of these states being approximately 150 Mev. (tr-auth)

25744 SPUTTERING OF COPPER BY Ne^+, Ar^+, Kr^+, AND Xe^+ IONS IN THE ENERGY REGION OF 75 kev TO 1 Mev. Dupp, Guenter; Scharmann, Arthur (Univ., Giessen, Ger.). Z. Phys., 192: 284-98(1966). (In German).

Using a 1.3 Mev Van de Graaff-accelerator the sputtering ratio S of polycrystalline copper bombarded by normally incident Ne^+-, Ar^+-, Kr^+-, and Xe^+-ions was measured in the energy range from 75 kev to 1 Mev. In the case of Kr^+-ions a broad, plateau-like maximum of the sputtering-curve S = f(E) was found at about 100 kev, for Xe^+-ions a more pronounced maximum at about 125 kev. The results are discussed applying the theories of Goldman-Simon, Pease, and Martynenko. (auth)

25745 AUGER SPECTRA FOR ELEMENTS OF LOW ATOMIC NUMBER. Fahlman, Anders; Nordberg, Ragnar; Nordling, Carl; Siegbahn, Kai (Univ., Uppsala). Z. Phys., 192: 476-83(1966).

The KLL Auger spectra for the light elements sodium (Z = 11) and magnesium (Z = 12) were studied. All five lines predicted by the extreme LS coupling theory are observed. A comparison is made with intensities predicted by the inter-configuration interaction theory of ASAAD. Agreement is obtained for the transition intensities to the three different KLL configurations; however, theory does not give correct relative intensities within the $2s^2\ 2p^4$ configuration. The measured Auger energies are compared with those calculated from the semi-empirical expression of ASAAD and BURHOP and modified by HÖRNFELDT. Good agreement is obtained when electron binding energies measured by the ESCA method are used. (auth)

25746 EXCITATION LINES AND MULTIPLE IONIZATION IN AUGER SPECTRA. Fahlman, Anders; Hamrin, Kjell; Axelson, Gunilla; Nordling, Carl; Siegbahn, Kai (Univ., Uppsala). Z. Phys., 192: 484-9(1966).

Satellite lines of a previously unreported type and excessively large continuous distributions of energy-degraded electrons are observed in the KLL Auger spectra of potassium, chlorine, and sulfur. The lines are tentatively interpreted in terms of a process that is characteristic of the atom more than of the entire solid, and the excessive number of electrons in the continuous distributions is interpreted in terms of multiple ionization. (auth)

25747 DIFFERENTIAL AND INTEGRAL CROSS SECTIONS FOR ELECTRON LOSS AND CAPTURE BY FAST N^+, Ne^+, AND Ar^+ IONS. Pivovar, L. I.; Novikov, M. T.; Dolgov, A. S. (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zh. Eksp. Teor. Fiz., 50: 537-45(Mar. 1966). (In Russian).

The charge distributions in beams of nitrogen, neon, and argon ions are measured as a function of the energy and scattering angle in single collisions with neon, argon, krypton and xenon atoms. At high energies of argon ions, L shell electrons are found to be involved in the interaction. The total differential scattering cross sections for nitrogen, neon and argon ions are compared with the calculated differential scattering cross sections for the case of a coulomb potential with exponential screening. Results of measurement of the total cross sections for capture of one or loss of several electrons by N^+, Ne^+ and Ar^+ ions in single collisions with neon, argon, krypton and xenon atoms are presented. The total cross sections obtained are compared with the data of other authors. (auth)

25748 CHARGE EXCHANGE OF PROTONS IN INERT GASES INVOLVING THE FORMATION OF FAST HYDROGEN ATOMS IN THE 2s AND 2p STATES. Andreev, E. P.; Ankudinov, V. A.; Bobashev, S. V. (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Eksp. Teor. Fiz., 50: 565-75 (Mar. 1966). (In Russian).

The excitation cross sections $\sigma(2s)$ and $\sigma(2p)$ for the 2s and 2p states of hydrogen atoms produced during charge exchange of 10–40 kev protons in He, Ne, Ar, Kr and Xe are determined by measuring the intensity of the first line of the Lyman series. The metastable 2s state of the hydrogen atom was destroyed by producing an electric field in the charge exchange chamber. The absolute intensity of the L_α line was determined on basis of the photoionization current in nitrogen oxide. In the proton energy range investigated the cross section $\sigma(2s)$ was found to grow monotonically only in helium; in all other cases the dependence of $\sigma(2p)$ and $\sigma(2s)$ on energy exhibited maxima. The peak values of the cross sections increase with growing atomic number of the target gas and are as high as $\sigma_m(2s) = 8.7 \cdot 10^{-17}$ cm^2 (Xe, E = 17 kev) and $\sigma_m(2p) = 1.2 \cdot 10^{-16}$ cm^2 (Xe, E = 11 kev). For proton energies $E < 25$ kev the cross section $\sigma(2s) < \sigma(2p)$; for $E > 25$ kev the ratio $\sigma(2s)/\sigma(2p) > 1$ and increases with decreasing atomic number of the target gas. (For helium $\sigma(2s)/\sigma(2p) = 4$ at E = 40 kev). (auth)

25749 MULTIPLE SCATTERING OF NITROGEN AND OXYGEN IONS IN ALUMINUM. Bednyakov, A. A.; Nikolaev, V. S.; Rudchenko, A. V.; Tulinov, A. F. (Moscow State Univ.). Zh. Eksp. Teor. Fiz., 50: 589-94(Mar. 1966). (In Russian).

The angular distributions of ^{14}N and ^{16}O ions with initial energies of 0.3 Mev per nucleon after multiple scattering in aluminum films are measured with aid of a set of proportional counters. The analysis of the data is carried out on basis of the Moliere theory. The agreement between the experimental and theoretical distributions is satisfactory if the mean square charge corresponding to an equilibrium distribution is employed in the calculations as the charge of the moving ion. (auth)

25750 SHADOW SCATTERING BY ATOMS. Bethe, H. A. (Cornell Univ., Ithaca, N. Y.). pp 240-9 of Preludes in Theoretical Physics. Amsterdam, North-Holland Publishing Co., 1966.

The calculation by Mott and Massey of the polarization potential acting on an incident electron by an atom is $V_p = -(ie^2a_0/2kr^3) + \varphi\ (1/k^2r^4)$ where a_0 is the Bohr radius. It is shown that the leading term, being purely imaginary, is due to the loss of electrons from the incident beam by elastic scattering and leads to an easy understanding as well as a simple calculation of the forward maximum. This maximum is the atomic counterpart of the well known shadow scattering in nuclear physics. (B.G.D.)

Cosmic Radiation

See also Elementary Particles and Radiations Nuclear Properties and Reactions

25751 (N-65-35246) RADIATION ENVIRONMENT IN SPACE. Keller, J. Warren (National Aeronautics and Space Administration, Washington, D. C.). [1964]. 36p. (NASA-TM-X-51568). CFSTI $2.00 cy, $0.50 mn.

The important components (for space vehicle design) of the indigenous radiation fields in space, including galactic cosmic radiation, solar cosmic radiation (solar protons); and the geomagnetically trapped radiation of natural origin and from the July, 1962, high-altitude nuclear detonation are under study. It was concluded that solar cosmic radiation is the dominating radiation environment for deep space vehicles which traverse the trapped radiation belts rapidly and is not completely defined or understood. It was stated that the major radiation effects problems from the indigenous radiations in space were with items on or near the surface of the vehicles. (STAR)

25752 STUDY OF RELATIVISTIC NUCLEUS-NUCLEUS COLLISIONS IN NUCLEAR EMULSIONS. Andersson, B.; Otterlund, I.; Kristiansson, K. (Univ. of Lund, Sweden). Ark. Fys., 31: 527-48(1966).

Eighty-eight nucleus-nucleus collisions produced in nuclear emulsions by heavy cosmic ray primaries were analyzed. The charge of the primaries falls in the interval 3 ≤

$Z \leq 26$ and the kinetic energy is larger than 1.7 Bev/nucleon. The angular distribution of the shower particles is composed of a narrow distribution probably of protons as the main constituent and a wider distribution which mainly consists of pions. The production of shower particles was found to be in good accord with what can be expected from the shower particle production in nucleon-nucleon interactions if the nucleon cascades in the target nuclei are considered. The angular distributions of the grey tracks are studied and found to be similar to the corresponding distributions in nucleon-nucleus collisions. The angular and the momentum distributions of the black prongs are consistent with a recoil momentum of the target nuclei of about 20 Mev/c per nucleon. All results are in agreement with the assumption that in the first approximation a nucleus-nucleus collision can be looked upon as a superposition of independent nucleon-nucleus collisions. (auth)

25753 COMPOSITION OF THE PRIMARY COSMIC RADIATION AND THE ABUNDANCE OF THE ELEMENTS IN NATURE. **Kristiansson, K. (Univ. of Lund, Sweden). Ark. Fys., 32: 285-305(1966).**

The relative abundance of protons, helium nuclei and heavier nuclei is discussed with special emphasis on the composition of the group of heavy nuclei. The amount of interstellar matter traversed by the radiation is estimated to 2.5 g/cm². The figure is a mean value of two determinations, one based on the amount of Li, Be, and B and the other on the amount of iron relative to the number of nuclei in the interval $17 \leq Z \leq 25$, which are all assumed to be spallation products from Fe + p reactions. The abundances of hydrogen, helium, oxygen, silicon and iron are extrapolated back to the cosmic ray source. Two comparisons are made between the abundances of these elements in the radiation and in nature. The first comparison is performed with the mean universal abundance according to the compilation by L. H. Aller. It is found that the excess of the heavy elements in the radiation is very large and follows approximately a relation $R \sim Z^{3.5}$ for $8 \leq Z \leq 26$. The second comparison is made with the composition of the solar corona reported by S. R. Pottasch. This comparison also shows an over-abundance of the heavy elements. The ratio between the abundance in the radiation and the abundance in the corona follows approximately the relation $R \simeq Z$ for particles above the same rigidity. The results are discussed and some conclusions are drawn regarding the injection of the particles into the mechanism of acceleration. (auth)

25754 MEASUREMENT OF THE POLARIZATION OF COHERENT RADIO EMISSION OF EXTENSIVE AIR SHOWERS (EAS). **Borzhkovskii, I. A.; Volovik, V. D.; Kobizskoy, V. I.; Shmatko, E. S. (Kharkov State Univ.). JETP Lett. (USSR)(Engl. Transl.), 3: 118-20(Feb. 15, 1966).**

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Redakt., 3: 186-90(Feb. 15, 1966).

The coherent radio emission polarized in the east-west direction was observed at a wavelength of 15.0 m with an amplifier bandwidth of ~1.4 Mc. (D.C.W.)

25755 POSSIBLE EXISTENCE OF A PASSIVE BARYON STATE. **Smorodin, Yu. A. (Lebedev Physics Inst., Moscow). JETP Lett. (USSR)(Engl. Transl.), 3: 125-8 (Mar. 1, 1966).**

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Redakt., 3: 197-201(Mar. 1, 1966).

It is shown that an extensive air shower with approximately 10^5 particles, which was observed falling at a zenith angle of 86 ± ½ deg, accompanied a nuclear interaction occurring under the installation in a layer 200 to 400 g/cm² thick. It is assumed for the calculation that the passive baryon has a lifetime of 2 (10^{-10}) sec, and a mass $Mc^2 = 10^9$ ev. It follows from the results that the cross section for the nuclear interaction of the baryon in the passive state does not exceed in order of magnitude 10^{-2} of the normal value. (J.F.P.)

25756 POSSIBLE SPECTRAL NEUTRALITY OF COSMIC RADIATION. **Brunstein, K. A.; Cline, T. L. (Goddard Space Flight Center, Greenbelt, Md.). Nature, 209: 1186-8(Mar. 19, 1966).**

A discussion is presented on recent observations from satellites which indicate a similarity between the low-energy relativistic cosmic ray electron and proton differential velocity spectra. The implications of experimental evidence for spectral neutrality of cosmic radiation and its consequence, an equality of the total numbers of electrons and of charged nucleons, which provides a new insight into the problem of the origin of cosmic rays are considered. An examination of interplanetary modulation is presented in order to interpret this spectral equality, and in particular to assert an extrapolation of it to the interstellar cosmic radiation. (B.G.D.)

25757 EVIDENCE FOR TWO TYPES OF HIGH-ENERGY MESON JETS. **Cohen, J. L.; Friedlaender, E. M. (Inst. of Atomic Physics, Bucharest). Nuovo Cimento (10), 43A: 200-5(May 1, 1966).**

The distribution of transfer momenta ω_T of photons from π^0-decay is computed in a statistical analysis of a sample of 46 high-energy cosmic-ray jets, starting from the p_T-distribution of charged pions, which is described by a superposition of two Boltzmann-type distributions, and assuming charge independence. Evidence is found for the existence of two classes of stars, and some average physical parameters are tabulated for each class. It is concluded that evidence points to the existence of two kinds of collisions that play a dominant part in the meson production processes. (L.B.S.)

25758 EMISSION OF π-MESONS IN THE BACKWARD HEMISPHERE IN THE 1.s. OF COSMIC-RAY JETS. Imaeda, K. (Dublin Inst. of Advanced Studies); Kazuno, M.; Peak, L. S.; Woolcott, R. L. S. Nuovo Cimento (10), 43A: 206-9(May 1, 1966).

Five meson jets that exhibited a track emitted in the backward hemisphere were found in an examination of 47 cosmic-ray jets. An analysis was made of the energy spectrum, charge ratio, angular distribution and P_T-distribution, and the results agree well with the assumption that the backward π-mesons are the decay products of isobars formed by the target nucleons. Experimental evidence tentatively suggests that there is a fair contribution to the isobars from masses higher than that of the ($^3/_2$, $^3/_2$) state of the nucleon. (L.B.S.)

25759 TRANSVERSE MOMENTUM DISTRIBUTION OF PHOTONS FROM HIGH-ENERGY COSMIC RAY JETS. **Cohen, J.; Friedlaender, E. M. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys., 11: 99-100(1966).**

An attempt was made to check which of two Boltzmann-type distributions for meson(π) transverse-momentum distributions produced in high-energy collisions gives a better fit to experimental findings. A modified version of a statistical method was applied to a sample of high-energy jets produced in carbon and recorded in an emulsion sandwich. From the results it appears that the properties of the transverse-momentum distribution of neutral mesons (π) from cosmic ray jets are sensitive enough to allow the detection of two types of collisions with different physical properties. (J.F.P.)

25760 COHERENT INTERACTIONS OF HIGH-ENERGY PROTONS WITH COMPLEX NUCLEI. **Abduzhamilov, Sh.; Azimov, S. A.; Chernova, L. P.; Chernov, G. M.; Chudakov, V. M. (Inst. of Nuclear Physics, Academy of Sciences, Uzbek SSR). Yadern. Fiz., 3: 657-62(Apr. 1966). (In Russian).**

Differences between the angular distributions of secondary particles in showers, due to high energy protons satisfying certain necessary selection criteria for pp and pn collisions in photoemulsion, are observed and investigated, using a method suggested previously. These differences indicate the possible existence of coherent interactions between protons and complex nuclei in showers with 3 or 5 secondary charged particles at 10 and 24 Bev. (auth)

25761 AZIMUTHAL ANGULAR DISTRIBUTIONS OF SECONDARY PARTICLES IN COSMIC-RAY SHOWERS. **Mishakova, A. P.; Nikol'skii, B. A. Yadern. Fiz., 3: 703-10(Apr. 1966). (In Russian).**

The azimuthal angular distributions of secondary particles in 169 showers with the energies 10^{10} to 10^{14} ev were

investigated using the pair angular correlation method. An isotropical azimuthal angular distribution was observed for primary showers, due to nucleons, and an anisotropical one for secondary showers, due to π-mesons. This indicates the different nature of NN- and πN-interactions at very high energies. The data on the angular correlations of secondary shower particles are discussed from the point of view of the fire-ball model. (auth)

Direct Energy Conversion

Refer also to abstracts 25961, 25965, and 26281.

25762 (INR-654/XVIII/PP) PARAMETRY ELEKTRYCZNE GENERATORA MAGNETOHYDRODYNAMICZNEGO PRZY ROZNYCH ELEKTRYCZNYCH POLACZENIACH ELEKTROD. CZESC II. ANALIZA DWUWYMIAROWA. (Electrical Parameters of the DC MHD Generator with Various Electrical Connections of Electrodes. Part II. Two-Dimensional Analysis). Celinski, Zdzislaw N. (Institute of Nuclear Research, Warsaw (Poland)). May 1965. 202p. Dep.

Electrical parameters in the d-c MHD generator with arbitrary connected electrodes were investigated. Constant gasdynamic parameters and constant generator cross section were assumed. A vector diagram technique is developed to investigate the electrical parameters in the MHD generators. Electrical equivalent circuits were found and terminal values of electrical parameters (current, voltage, power, internal resistance) were determined. The numerical method of the two-dimensional analysis of the MHD generator with arbitrary electrode connections was developed. A correction factor λ was calculated, the use of which makes it possible to correct one-dimensional theory equations for two-dimensional effects. (auth)

25763 (N-65-15252) THE ALPHA-CELL DIRECT-CONVERSION GENERATOR. Final Report. Plummer, A. M.; Gallagher, W. J.; Matthews, R. G.; Anno, J. N. (Battelle Memorial Inst., Columbus, Ohio). Nov. 30, 1964. Contract NAS3-2797. 114p. (NASA-CR-54256). CFSTI $4.00 cy, $0.75 mn.

Experiments performed on a generator in which alpha-particle kinetic energy is converted directly to electric energy resulted in a voltage buildup in the 50- to 100-hr range. Microdischarging in the experimental cell was determined to be the factor preventing higher voltage buildup. The experiments also provided information on generator design, especially on the factors influencing control of secondary electrons by an electric grid. Methods of converting the high-voltage (megavolt range) expected from improved experimental cells to lower voltage were also investigated. A converter incorporating a piezoelectric transformer was designed. (STAR)

25764 (N-65-32965) EFFECT OF ADDING TUNGSTEN FILLER MATERIAL TO BERYLLIA-MAGNESIA THERMAL STORAGE MATERIAL IN A SOLAR THERMIONIC POWER SYSTEM. Bifano, William J.; Ward, James J. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Sept. 1965. 28p. (NASA-TN-D-2978). CFSTI $2.00 cy, $0.50 mn.

An investigation of the effect on system specific weight of adding tungsten filler material to beryllia magnesia (3 BeO-2 MgO) thermal storage material in a solar thermionic power system is presented. A one-dimensional steady-state heat-transfer analysis was used to determine system performance. A transient heat-transfer analysis and a discussion of thermal control requirements and variations in electrical output power during an orbit are appended. The results indicate that the addition of tungsten to the 3 BeO-2 MgO does not lower the specific weight of the system, although small amounts may be added to relieve thermal stresses, for example, without increasing the specific weight significantly. In addition, it was found that by means of a variable generator aperture, an output power variation of less than 6% can be maintained through a light-dark cycle for a system designed for a maximum cavity temperature of 2200°K operating with a fixed load resistance. (auth)

25765 (N-65-35354) HIGH-PERFORMANCE THERMIONIC CONVERTER. Quarterly Progress Report, May 13-August 13, 1965. Campbell, A. E.; Pollock, D. H. (Electro-Optical Systems, Inc., Pasadena, Calif.). Aug. 23, 1965. Contracts NAS7-100; JPL-951225. 91p. (NASA-CR-67299; EOS-6952-Q-1). CFSTI $3.00 cy, $0.75 mn.

For Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

Radiator heat rejection studies have been concerned with investigations of coating stability, fabrication of collectors, and high-temperature brazing. Rokide "C" coatings of .002" on molybdenum and copper were found to be stable at 600°C for periods in excess of 500 hours. The effective emissivity for these coatings is found to be 0.78 and does not change at 600°C for thicknesses between .002 and .006". There was no peeling, chipping, degradation, or evaporation of these coatings over the 500-hour test in a 10^{-7} mm Hg ion-pumped environment. A Cu radiator-Mo collector was fabricated, and testing indicates that it retains the integral strength of the Mo collector-radiator while it is better than Mo on a heat rejection per unit weight basis. An Mo collector with Cu inserts was fabricated, and calculations indicate improved effective thermal conductivity of the collector barrel. Re-Nb braze joints, using V as the brazing material, appear to be brittle and do not exhibit any brittle intermetallic compounds when the correct braze schedule is used. (STAR)

25766 (N-65-35576) A MAGNETOGASDYNAMIC POWER GENERATION STUDY. Third Quarterly Progress Report. Sherman, Arthur; Shair, Fredrick H.; Smith, John M. (General Electric Co., Philadelphia, Pa. Missile and Space Vehicle Dept.). June 30, 1965. Contract NAS3-6260. 22p. (NASA-CR-67370). CFSTI $1.00 cy, $0.50 mn.

Calculations were carried out on a preionized plasma in a flowing system with finite recombination rates. The results were compared to experimental results obtained with the electron beam. The correlation between theory and experiment was excellent. In addition, experiments were conducted with an applied voltage on one pair of the generator electrodes with a flowing system. Voltage-current traces were obtained when the applied electric field was either aided or opposed by a $U \times B$ induced electric field. Some estimates of sheath voltages were obtained, and the characteristics of the body of the ionized plasma could be estimated. A supersonic nozzle and test section were designed and fabricated. A review of the concept of an MHD generator coupled to a space power system was made. (STAR)

25767 (NASA-CR-67221, pp 2,6-10) EMITTER SURFACE PHYSICS OF PLASMA DIODES. Zelby, Leon W.; Schrenk, George L.; Kaplit, M. (Pennsylvania Univ., Philadelphia. Inst. for Direct Energy Conversion). 4p.

Research toward obtaining a microscopic understanding of the limitations of the semi-classical phenomenological model of the emitter surface of a thermionic energy converter is presented. Quantum mechanical calculations are given for the microscopic charge distribution of the emitter surface, a metal-vapor interface, and the resulting charge distributions were used to determine some of the limitations of the semi-classical model of a metal-vapor interface. (M.O.W.)

25768 (N-65-36757) DEVICE FOR CONVERTING THE IONIZING ENERGY, EMERGING FROM A NUCLEAR REACTOR, INTO ELECTRICITY. Klein, Siegfried; Kraus, Pierre. Translated from a paper presented at the Sixth AGARD Combustion and Propulsion Colloquium, Cannes, France, 16-20 March 1964. 14p. (NASA-TT-F-9598). CFSTI $1.00 cy, $0.50 mn.

A device is described in which an electromotive force is created by keeping two hollow metal electrodes, in contact with mercury under vacuum, at different temperatures. Use of gases such as argon, neon, and helium which do not condense under the experimental conditions did not lead to the generation of an emf. A modified device, using a zirconium

alloy bar in a UO_2-lined steel tube and floating in the heavy water of the reactor, was successful for direct conversion of the ionizing energy of fission products into electricity. An increase in electric power generated was obtained by using completely ionized cesium vapors and a heavier uranium oxide lining. (STAR)

25769 EFFICIENCY OF THE MHD PROCESS WITH SODIUM AS FLUID. Freund, J. H. (Technische Univ., Berlin). Atomkernenergie, 11: 221-3(May-June 1966). (In German).

The advantage of the MHD-process of having no moving components is accompanied by the disadvantage of its low efficiency. This is due to losses in the steam-jet-condensor. By arranging the process in stages it is possible to reduce the loss and to improve its efficiency. (auth)

25770 THERMIONIC ENERGY CONVERTER IN A MAGNETIC FIELD. Fahnrich, J.; Tomova, E. (Charles Univ., Prague). Czech. J. Phys., 15: 276-86(1965).

A thermionic converter uses the thermal energy of electrons emitted by a glowing cathode to produce electric power. The converter is a source of low voltage at high current. The strong magnetic field generated in the converter has an adverse effect on its operation. The effect of this magnetic field can be demonstrated experimentally by placing a diode which produces a relatively weak current in an external magnetic field. The effect of an external magnetic field on a converter with cesium vapor was studied for two sets of conditions: quasi-vacuum conditions in which the mean free path of the electrons in the cesium vapor is greater than the distance between the cathode and the collector, and diffusion conditions where the Cs vapor pressure is higher and the collisions of electrons with cesium atoms can no longer be neglected. An expression is derived for the current passing through the diffusion converter as a function of a homogeneous external magnetic field. This current was experimentally measured as a function of the magnetic field over a wide range of cesium vapor pressures in both types of converters. The results show excellent qualitative agreement between experiment and theory. The experimental results are regarded as qualitative verification of the effect of the inherent magnetic field in the converter. (ATD)

25771 OPTIMIZATION OF SUPERCONDUCTING MAGNETIC SYSTEMS OF MHD GENERATORS. Kartsev, V. P.; Sapozhnikova, A. M.; Sychev, V. V. Elektrichestvo, No. 11, 22-5(Nov. 1965).

Superconducting magnetic systems for MHD generators (with or without ferromagnetic cores) should offer significant advantages as compared with the usual systems because they are much smaller in weight and size; they use much less electric power for self-consumption; the size of the entire MHD generator may be reduced by increasing the field strength within the generator channel; and there is an automatic damping of the current reaction within the generator plasma and the generator emf is independent of the load, due to the properties of the superconductive circuit which maintains the current constant. The design of superconductive magnetic systems has distinctive peculiarities (the existence of a critical current beyond which the conductor stops being superconductive; the superconductor critical current varies in a sharply nonlinear manner with the magnetic field strength; very high cost of superconductor material). Consequently, the methods for the determination of rational geometric dimensions of a superconducting magnetic system without a permanent core are investigated. Following the formulation of the pertinent theoretical relations the actual optimization calculation was carried out on the electronic digital computer "Ural-1." (ATD)

25772 ELECTRODELESS MAGNETOHYDRODYNAMIC INDUCTION CHAMBER WITH A RADIAL MAGNETIC FIELD. Kracik, Jiri (Technical Univ., Prague). Elektrotech. Obz., 54: 430-5(Sept. 1965).

A theoretical treatment is given for the possibility of generating an alternating current of high voltage in a magnetohydrodynamic induction chamber of a new type. Instead of an axial magnetic field of the exciting coil, a very strong radial magnetic field is employed to generate very efficiently an azimuthal current in the plasma by the magnetohydrodynamic force. Formulas are derived for a continuous plasma flow of constant velocity through the chamber, defining the voltage across the collecting coil, the electric current in the external circuit and the electric output. It is proved that the output is maximum not only for a certain resistance of the external circuit of the generator but also for a certain length of the chamber and for a certain frequency of the generated current. An analogous derivation can also be carried out for pulse operation. (ATD)

25773 OPTIMAL DYNAMIC OPERATIONS OF MAGNETOGASDYNAMIC ENERGY CONVERTER. Pushkarev, O. E. Magnit. Gidrodin., No. 1, 55-64(1966). (In Russian).

Optimum dynamic regimes of operation of MGD converter with constant local electric efficiency and constant magnetic field are investigated using the one-dimensional equations for the flow of a conducting gas in a duct. The validity limits for the one-dimensional approximation of electric and magnetic quantities are determined. The optimum condition closing the system of MHD equations for the MGD converter is found. Simple analytic solutions for certain concrete cases are obtained. (auth)

25774 ESTIMATION OF THE EFFECT OF THE DEGREE OF IONIZED GAS EXPANSION IN THE NOZZLE ON THE SPECIFIC POWER OF AN MHD GENERATOR. Yantovskii, E. I. Magnit. Gidrodin., No. 1, 153-6(1966). (In Russian).

A simple and intuitive picture of the dependence of the power density of energy conversion in the magnetic field on the degree of gas expansion in the nozzle is given for a minimum number of present parameters, by examining the velocity dependence of the volumetric and linear power densities at the channel entrance. Results are shown of numerical calculations of the dimensionless power densities as functions of dimensionless velocity for various values of the index of adiabatic expansion of the gas in the nozzle at a ratio of critical temperature to ionization temperature of 0.05. (M.J.T.)

25775 METHOD AND APPARATUS FOR GENERATING ELECTRICITY. Kehoe, Edward Charles (to Scientific Developments, Inc.). British Patent 1,024,628. Mar. 30, 1966. Filed Dec. 31, 1962.

A method for converting mechanical energy into electrical energy includes the steps of generating an electric arc, forcing the arc along a predetermined path by subjecting the arc to a flowing gas, and abstracting the electrical energy from the arc as it moves along the path. The electric arc is a high temperature stream or rod of ionized gas of relatively small cross sectional area. The generator for carrying out the process includes two electrodes provided to form a passage extending intermediate of the pole faces of one or more magnets. The electrodes have arc generating means connected to them for producing an electric arc between predetermined portions of the electrodes and between the pole faces. Gas pressure means are provided for forcing gas through the passage to move the arc along the electrodes. (B.L.M.)

25776 ELECTRO-OPTIC ISOTOPE BATTERY. Scharmann, Arthur; Euler, Joachim (to Varta Aktiengesellschaft). German Patent 1,211,343. Feb. 24, 1966. Filed Jan. 27, 1962.

The nuclear battery is a layer cake-like assembly composed of a central layer of radioactive material and phosphor and two outer layers of pure phosphor, in which nuclear energy is turned to light, which is turned to electricity by photocells forming the outside layers of the battery. The thickness of the two layers of pure phosphor is about equal to the practical range of the beta rays from the radioactive material, and the thickness of the whole phosphor layer is about equal to the optical thickness. (Gmelin Inst.)

25777 FISSION ELECTRIC GENERATOR. Krieve, Walter F. (to U. S. Atomic Energy Commission). U. S. Patent 3,219,849. Nov. 23, 1965.

A fission electric generator in which the positive fission products emitted from a fissionable material cathode are captured by an anode adjacent the cathode, said anode having relatively thin walls whereby Compton and beta decay electrons pass through the anode to be captured by an extension of said cathode on the opposite side of said anode is described. (AEC)

Elementary Particles and Radiations

See also Field Theory, Scattering Theory, and Symmetries

Refer also to abstracts 26214 and 26237.

25778 (BNL–10166) MUEFF—AN IBM 7094 MONTE CARLO CODE FOR MUON-PROTON SCATTERING. Bender, Steven; Kaplan, Stanely (Brookhaven National Lab., Upton, N. Y.); Tannenbaum, Michael (Brookhaven National Lab., Upton, N. Y. Columbia Univ., New York). Apr. 12, 1966. Contract AT-30-2-GEN-16. 85p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

Computer programs were written to determine the apparatus detection efficiency in terms of q^2, the 4-momentum transfer^2 of the collision, and the incident muon momentum at the point of interaction. Detailed listings of the programs and their functions are included. (M.O.W.)

25779 (CEA-R-2838) MESURE DES SECTIONS EFFICACES TOTALES π^+p ET π^-p ENTRE 700 ET 1700 Mev ET APPLICATIONS AUX RELATIONS DE DISPERSION [Theses]. (Measurement of the π^+p and π^-p Total Cross Sections From 700 to 1700 Mev and Applications to the Dispersion Relations [Thesis]). Stirling, Alexandre V. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 1966. 64p. Dep. mn.

Submitted to Paris Univ., Orsay (France). Faculte des Sciences.

The π^+p and π^-p total cross sections were measured between 500 and 1700 Mev to eliminate discrepancies in the experimental data. These new values have permitted a more precise calculation of the forward dispersion relation These relations are well satisfied by the experimental data up to 18 Bev for charge exchange scattering. The dispersion relation for the spin-flip amplitude gives an efficient test for the phase-shift analysis solutions. (auth)

25780 (CERN–66-13) NEUTRINO INTERACTIONS IN THE CERN HEAVY LIQUID BUBBLE CHAMBER. Franzinetti, C. (European Organization for Nuclear Research, Geneva (Switzerland)). Mar. 28, 1966. 64p. (CONF-651015–23). Dep. mn.

From American Physical Society, Chicago.

A summary is presented of the results obtained from the analysis of events observed in the CERN Heavy Liquid Bubble Chamber, when exposed to the neutrino beam during the period 1963-1964. The experimental equipment is briefly described. In particular, summaries are given for the following: search for intermediate vector boson, hypothetical ($p\mu^-$) resonance, elastic interactions, elastic production of hyperons by antineutrinos, single-pion production, Adler's test of the partially conserved axial current hypothesis, and miscellaneous data on inelastic events. (M.O.W.)

25781 (COO–1195-56) ANNUAL PROGRESS REPORT [ON ELEMENTARY PARTICLE PHYSICS, 1965]. (Illinois Univ., Urbana. Dept. of Physics). Apr. 1966. Contract AT(11-1)-1195. 45p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Some investigations of resonance production in π^--p, π^+-d, K^--p, and p-p interactions at high energies, strange particle production in p-p interactions, π-N coupling, photoproduction of mesons (π^-), and the decay of mesons (K_2^0) are summarized. Efforts in the development of counters, wire spark chambers, and data analysis systems are also outlined. (D.C.W.)

25782 (DESY–66/8) DERIVATION OF SUM RULES FOR ELECTROMAGNETIC ISOVECTOR FORM FACTORS. Kramer, G.; Meetz, K. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Apr. 1966. 12p. Dep. mn.

Starting with equal time commutation relations for the isospin current densities, sum rules for isovector form factors are derived in a manifestly covariant way. Locality is taken into account by means of dispersion relations. For scalar and pseudoscalar particles the most general sum rule is obtained. This sum rule is applied to electromagnetic form factors of mesons and nucleons. (auth)

25783 (INR–662/VII/PH) HARD CORE NUCLEON SYSTEM WITH NEUTRON EXCESS. Dabrowski, Janusz; Hassan, M. Y. M. (Institute of Nuclear Research, Warsaw (Poland). Warsaw Univ. (Poland). Inst. for Theoretical Physics). Oct. 1965. 30p. Dep.

The known expansion of the ground state energy of a system of hard core fermions in powers of k_Fc/k_F = Fermi momentum, where c = hard core radius, is extended to include the case of nuclear matter with a neutron excess and the case of one kind of fermions (e.g. liquid ^{3}He) with a "spin up excess." The calculation includes terms quadratic in k_Fc. Expressions for the nuclear symmetry energy and the spin symmetry energy are given. An approximation applied earlier by Brueckner et al. in computing both of these quantities is discussed. (auth)

25784 (ISS–66/1) A STATISTICAL ANALYSIS OF THE LIMIT ON THE BREAKDOWN OF QUANTUM ELECTRODYNAMICS ATTAINABLE WITH ELECTRON-POSITRON COLLIDING-BEAM MACHINES. Amaldi, U. Jr.; Biancastelli, R.; Stein, P. (Istituto Superiore di Sanita', Rome (Italy). Laboratori di Fisica). Jan. 15, 1966. 35p. Dep. mn.

In the hypothesis that there is no breakdown of quantum electrodynamics, the upper limits which can be put on a simple breakdown parameter performing $e^+ + e^- \rightarrow e^+ + e^-$, $e^+ + e^- \rightarrow \gamma + \gamma$ and $e^+ + e^- \rightarrow \mu^+ + \mu^-$ experiments at different energies with a "reasonable" apparatus are obtained. While the discussion of the $\mu^+\mu^-$ experiment is simple, the first two reactions, whose angular distribution is sensitive to the breakdown, are studied simulating experiments on the IBM 7040 computer and then analyzing them by means of the maximum likelihood method. The effects of experimental inefficiencies and of errors introduced in correcting the data for radiative processes are considered. (auth)

25785 (JINR–P-2582) DISPERSIONNYI ANALIZ UPRUGOGO RACCEYANIYA CHASTITS V OBLASTI VYSOKIKH ENERGII. (Dispersion Analysis of Elastic Scattering of High-Energy Particles). Barashenkov, V. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1966. 45p. Dep. mn.

Experimental data on measurement of the real part of the elastic πN and NN scattering amplitude at zero angle are discussed. The experiment is compared with the results of dispersion calculations. (auth)

25786 (JINR–P-2630) RELYATIVISTSKOE VOSSTANOVLENIE MATRITSY N-N RASSEYANIYA. (Relativistic Reconstruction of N-N Scattering Matrix). Bilen'kii, S. M.; Lapidus, L. I.; Ryndin, R. M. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1966. 25p. Dep. mn.

It is shown how the nucleon-nucleon scattering matrix can be reconstructed from the experimental data at fixed values of the angle and energy in the relativistic case. Different reconstruction procedures are considered. Relativistic formulas were obtained for reconstructing nucleon-nucleon scattering matrix in the state with total non-zero isospin from the n-p and p-p scattering data. (auth)

25787 (JINR-P-2632) INTERFERENTSIYA RASPADOV $K_L \rightarrow \pi^+\pi^-$ IK$_S \rightarrow \pi^+\pi^-$ V KORRELYATSIONNYKH EKSPERIMENTAKH S PARAMI $\bar{K}^0\bar{K}^0$. (Interference of $K_L \rightarrow \pi^+\pi^-$ and $K_S \rightarrow \pi^+\pi^-$ Decays in Correlation Experiments with $\bar{K}^0\bar{K}^0$ Pairs). Lyuboshits, V. L.; Okonov, E. O. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1966. 10p. Dep. mn.

The interference is considered of long-lived (K_L) and short-lived (K_s) neutral K-mesons into two charged π-mesons in the $K^0 \bar{K}^0$ pair production. It is shown that the study of interference phenomena in the correlation experiments involving $K^0 \bar{K}^0$ pairs allows one to determine the magnitude and relative phase of the small admixture states with even (or odd) orbital angular momenta in the $K^0 \bar{K}^0$ system. (auth)

25788 (LNF–66/16) SINGLE BOSON PRODUCTION IN ADONE. Note No. 315. Bartoli, B.; Bernardini, C.; Felicetti, F.; Silvestrini, V.; Vanoli, F.; Vitale, S. (Laboratori Nazionali di Frascati, Comitato Nazionale per l'Energia Nucleare (Italy)). Mar. 30, 1966. 15p. Dep. mn.

The experimental setup and methods for detecting neutral nonstrange boson production from e^+e^- collisions in Adone is described. The use of Adone as a boson mass spectrometer is briefly discussed. (M.O.W.)

25789 (N–65–35413) A POSTULATED LAW FOR THE MASSES OF THE ELEMENTARY PARTICLES. Mirman, R. (New York Univ., N. Y. Dept. of Physics). [1961]. 15p. (NASA-CR–67390). CFSTI $1.00 cy, $0.50 mn.

The formula previously postulated for the masses of the elementary particles is stated in a revised form and is shown to be in good agreement with the empirical masses. The existence of a neutral shift is shown. The implications of these facts are discussed. The possible application of the formula to resonances is considered. (STAR)

25790 (NP–15964) REPORT ON RECENT EXPERIMENTAL DATA [ON ELEMENTARY PARTICLES], 1965. Report No. 40. Venkatesan, K. (Institute of Mathematical Science, Madras (India)). 176p. Dep. mn.

The set of reports on Recent Experimental Data issued every month during the year 1965 are included. The production of the antideuteron is discussed. The continuing search for quarks is discussed. A crop of new resonances are reported and the work of the Maglic group who have suggested a new method for locating resonances quickly and have applied it to the boson spectrum up to 2.5 Bev is reported. (M.O.W.)

25791 (PAEC(A)PH–663) THE NUCLEAR FORCE EQUATIONS. Eugenio, Manuel R.; Davila, Aida T. (Philippine Atomic Energy Commission, Manila). Apr. 1966. 7p. Dep. mn.

A binding energy per nucleon (B/A) curve was drawn and corrected for the Coulomb effect. An equation was fitted to the curve: $B/A = 11.8\,(1 - e^{-0.3\sqrt{A}})$. Through two differentiations and various numerical substitutions for A, some interesting relationships between nuclear force and nuclear matter were obtained. (M.O.W.)

25792 (UCRL-16282) DIFFERENTIAL DISTRIBUTIONS OF π^+ IN THE REACTION $\pi^-p \rightarrow \pi^+\pi^-n$ FROM 500 TO 700 Mev [Thesis]. Giancoli, Douglas Charles (Lawrence Radiation Lab., Univ. of California, Berkeley). Mar. 10, 1966. Contract W-7405-eng-48. 78p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

The energy distributions of the π^+ in the reaction $\pi^-p \rightarrow \pi^+\pi^-n$ were measured at several π^+ angles for incident π^- beam energies of 516, 550, 599, 667, and 715 Mev. The negative-pion beam was obtained from the Berkeley Bevatron. The energies of the π^+ were measured with a magnetic spectrometer consisting of a C-magnet with thin-walled aluminum spark chambers to display the trajectory of the particle entering and leaving the magnet. An array of scintillation counters was used to detect the occurrence of an event. An electronic time-of-flight system was used to distinguish positive pions from protons, which also pass through the spectrometer. The distributions at each angle were integrated over energy to obtain the differential cross sections, $d\sigma/d\Omega^*$. The measured spectra cannot be adequately explained by the statistical model nor by an isobar model, although production of the N^*_{33} isobar is present. (auth)

25793 INFLUENCE OF THE CRYSTAL ORIENTATION ON ANGULAR DISTRIBUTION OF PHOTONS FROM TWO-QUANTUM ANNIHILATION IN MONOCRYSTALS NaCl AND KCl. Rozenfeld, B.; Swiatkowski, W.; Wesolowski, J. (Wroclaw Univ.). Acta Phys. Pol., 29: 429-35(Apr. 1966).

Angular distributions of photons from the annihilation of positrons in NaCl and KCl monocrystals were measured. A dependence of these distributions on the orientation of the crystals was found. An attempt to interpret the results was made, based on the model of collective electrons for NaCl and KCl crystals. The magnitude and character of the change in experimental angular distributions resulting from change of the orientation of the crystal were found to be in agreement with those estimated on the basis of the model. The results show that the factor having decisive influence on the distribution of peripheral electron momenta in ionic crystals is the structure of the crystal lattice. (auth)

25794 MODIFIED STATISTICAL INTERPRETATION OF THE DIRAC ELECTRON THEORY SUGGESTED BY THE FW TRANSFORMATION. Hanus, Wanda (Nicholas Copernicus Univ., Torun, Poland). Acta Phys. Pol., 29: 463-75(Apr. 1966).

A new scheme for the statistical interpretation in configuration space is proposed for the Dirac electron theory. The basic assumption is that the localization of the electron ought to be carried out by means of the projection operator onto the subspace of the eigenstates of the mean-position operator introduced by Foldy and Wouthuysen. The internal consistency of the proposed scheme is verified, and explicit formulas for redefined probability and probability current densities (fulfilling a generalized continuity equation) are deduced in the Foldy and Wouthuysen representation in the case of the free electron. The nonrelativistic limit of these formulas and their correspondence with those of the Pauli theory are discussed. (auth)

25795 MOMENTUM DETERMINATION OF LOW-MOMENTUM PARTICLES IN EMULSIONS EXPOSED TO A STRONG MAGNETIC FIELD. Villar, E.; Llosa, R.; Gil, D.; Tarrega, P.; Lleo, A. (Facultad de Ciencias, Valencia). An. Real Soc. Espan. Fis. Quim. (Madrid), Ser. A, 61: 337-40(Nov.-Dec. 1965).

A method is given for determining the momenta of high-energy primary and secondary particles by application of strong magnetic fields to nuclear emulsions when the ratio between Coulomb and curvature sagitta is large. The method was also checked experimentally. (J.F.P.)

25796 DEUTERON POLARIZABILITY AND ELASTIC SCATTERING OF DEUTERONS. Bencze, Gy. (Univ. of Helsinki). Ann. Acad. Sci. Fenn., Ser. A VI, 194: 1-10 (1966).

The elastic scattering of deuterons in the Coulomb field of the nucleus is investigated. A nonlocal effective potential is derived for the elastic scattering, which takes into account both the real and the virtual breakup of the deuteron. Finally, a local approximation for this potential is suggested, which is suitable for phenomenological analysis. (auth)

25797 POLARIZATION OF CHERENKOV RADIATION PRODUCED BY THE β-RAYS OF ^{32}P AND ^{90}Y. Aiginger, H.; Unfried, E. (Oesterreichische Hochschule, Vienna). Atomkernenergie, 11: 224-8(May-June 1966). (In German).

The polarization of Cherenkov radiation produced in thin foils of cellulose acetate by polarized β rays from ^{32}P and ^{90}Y was investigated by counting coincidences between the electrons that traversed the foils without change in direction and the light quanta emitted at an angle of 45° with respect to the track of the particles. The degree of polarization was measured by means of a polarizing filter as a function of the foil thickness. The radiation of the thinnest foil (22 μ) was almost completely linearly polarized. This result was in agreement with results obtained with unpolarized electrons and with the theory of Cherenkov radiation. (auth)

25798 SPIN PRECESSION IN A GRAVITATIONAL FIELD. Kobzarev, I. Yu.; Zakharov, V. I. (Inst. for Theoretical and Experimental Physics, Moscow). Ann. Phys. (N. Y.), 37: 1-6(Mar. 1966).

The equality of precession frequencies of electron spin and a classical gyroscope in a gravitational field is discussed. It is shown that it follows from the linearized interaction $L_{int} = -\frac{1}{2} h_{ik}T_{ik}$, as well as from the iterated Dirac equation in four-leg formulation. (auth)

25799 RESONANTLY SCATTERED WAVE PACKETS. Goebel, C. J.; McVoy, K. W. (Univ. of Wisconsin, Madison). Ann. Phys. (N. Y.), 37: 62-76(Mar. 1966).

The effect of a resonant scattering on the shape of a (spherical) wave packet is investigated for the case of an incident packet that is Lorentzian in momentum. In the elastic case, packets both broader and narrower than the resonance are considered, and the relation of their time-delays to the Wigner-Eisenbud estimate are clarified. The effects on the elastically scattered packet of a double-pole resonance and of inelasticity are obtained as well. (auth)

25800 VELOCITY OF HIGH-ENERGY GAMMA RAYS. Alvaeger, T.; Bailey, J. M.; Farley, F. J. M.; Kjellman, J.; Wallin, I. Ark. Fys., 31: 145-57(1966).

The velocity of γ rays of energy ≥ 6 Bev from the decay of π^0 mesons in flight was measured to be $(2.9979 \pm 0.0004) \cdot 10^{10}$ cm/sec. The investigation was especially designed to test the second postulate of special relativity, i.e., that the velocity of electromagnetic radiation is independent of the motion of its source. If the difference between the measured velocity of the γ rays and the accepted value of the velocity of light is written $k \cdot v$, where v is the velocity of the π^0 mesons, it is found that $k = (0 \pm 1.3) \cdot 10^{-4}$. (auth)

25801 ON THE UNITARY IRREDUCIBLE REPRESENTATIONS OF THE (1 +4) DE SITTER GROUP. Kihlberg, A.; Stroem, S. (Inst. of Theoretical Physics, Goteborg). Ark. Fys., 31: 491-508(1966).

The unitary irreducible representations of the covering group of the (1 + 4) de Sitter group are determined using a method based on infinitesimal transformations in the group spaces of the first two subgroups K and A in the canonical decomposition $G = K \cdot A \cdot N$ of any semi-simple Lie group. (auth)

25802 APPLICATION OF PHOTOGRAPHIC EMULSIONS AND PULSED MAGNETIC FIELDS TO THE MEASUREMENT OF THE MAGNETIC MOMENT OF THE Λ HYPERON. Rosselet, Ph. Helv. Phys. Acta, 38: 691-716(1965). (In French).

The conditions of an experiment to measure the magnetic moment of the Λ hyperon, using photographic emulsions, are studied. After a discussion of the general principles of magnetic moment measurements, the relativistic equation of the spin precession is established in a simple form, and integrated for initial conditions corresponding to interesting particular cases. The optimum values of different geometrical and kinematical parameters are determined. The special coils built in view of this experiment are then described, and their electric characteristics computed. These coils, which were pulsed several thousand times at 150,000 gauss, are among the first to abandon the traditional geometry with axial symmetry of Bitter's type coils. Finally the problem of the detection and identification of the events (Λ decays) is discussed, and the effect of possible scanning biases is considered. (auth)

25803 ON A POSSIBLE METHOD OF VERIFYING CPT INVARIANCE IN pp SCATTERING. Bilen'kii, S. M. (Joint Inst. of Nuclear Research, Dubna, USSR). JETP Lett. (USSR)(Engl. Transl.), 3: 74-6(Feb. 1, 1966).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Redakt., 3: 118-21(Feb. 1, 1966).

It is shown that CPT invariance implies that $\vec{P}^{(1)} \cdot \vec{n} = \vec{A}^{(2)} \cdot \vec{n}$ and $\vec{P}^{(2)} \cdot \vec{n} = \vec{A}^{(1)} \cdot \vec{n}$ where $\vec{n} = (\vec{p} \times \vec{p}')/|\vec{p} \times \vec{p}'|$ is the normal to the scattering plane ($\vec{p}$ and $\vec{p}'$ are the momenta of the initial and final antiprotons in the cms), $\vec{P}^{(1)}(\vec{P}^{(2)})$ is the antiproton (proton) polarization produced upon scattering of unpolarized particles, and $\vec{A}^{(1)}(\vec{A}^{(2)})$ is the asymmetry occurring when a polarized antiproton beam is scattered by an unpolarized target (unpolarized beam is scattered by a polarized proton target). (G.O.Y.)

25804 CONCERNING THE DECAY $K_L^0 \rightarrow \pi^+ + \pi^-$. Khalfin, L. A. (Steklov Mathematics Inst., Leningrad). JETP Lett. (USSR) (Engl. Transl.), 3: 81-4(Feb. 1, 1966).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Redakt., 3: 129-34(Feb. 1, 1966).

An explanation is proposed for the apparent violation of CP invariance in $K_L^0 \rightarrow \pi^+ + \pi^-$ decays. (D.C.W.)

25805 CONCERNING TWO-NUCLEON RESONANCES. Dal'karov, O. D. JETP Lett. (USSR)(Engl. Transl.), 3: 94-6(Feb. 1, 1966).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Redkat., 3: 150-2(Feb. 1, 1966).

A mechanism is proposed to explain the anomalous behavior of the differential cross section of the reaction $p + d \rightarrow p + x$ as a function of the missing mass m_x. The mechanism is based on the notion that the incident proton interacts with one of the nucleons of the deuteron forming an isobar N* which is subsequent by scattered inelastically by another nucleon. This isobar might be the N*(1401). (G.O.Y.)

25806 INELASTIC INTERACTIONS OF NUCLEONS AND NUCLEI AT HIGH ENERGY. Nikol'skii, S. I. (Lebedev Physics Inst., Moscow). JETP Lett. (USSR) (Engl. Transl.), 3: 97-9(Feb. 15, 1966).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Redakt., 3: 153-6(Feb. 15, 1966).

It is assumed that when nucleons and nuclei of ultrahigh energy collide there exists, besides the known multiple pion-production process occurring in the $10^{10}-10^{13}$ ev region, also a process wherein a large fraction ($\sim 70\%$) of the nucleon energy is transferred to the electron-photon component, bypassing pionization. It is further assumed that in the same energy interval the exponent of the energy spectrum of the primary cosmic radiation changes by an amount $\Delta \simeq 0.5$. It is shown that by including these two assumptions, the different phenomena in extensive air showers can be explained more satisfactorily. (G.O.Y.)

25807 USE OF A HELIUM TARGET TO DETERMINE THE SPIN AND PARITY OF MULTIMESON RESONANCES. Dubovikov, M. S. (Moscow Physico-Technical Inst.). JETP Lett. (USSR)(Engl. Transl.), 3: 99-101(Feb. 15, 1966).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Redkat., 3: 156-9(Feb. 15, 1966).

It is shown that if the resonance of interest is produced in the reaction $\Pi + {}^4He \rightarrow B + {}^4He$ (Π = pion or kaon), then it may be possible to determine the spin and parity of B by studying the angular distribution of the normal to the decay plane of this resonance (in the rest system of B). The method proposed is based on the relations between different polarization effects in parity-conserving processes. (G.O.Y.)

25808 CHECK OF C INVARIANCE IN PHOTOPRODUCTION OF STRONGLY INTERACTING PARTICLES. Rekalo, M. P. (Physico-Technical Inst., Academy of Sciences, Ukrainian SSR). JETP Lett. (USSR)(Engl. Transl.), 3: 101-3(Feb. 15, 1966).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Redkat., 3: 160-3(Feb. 15, 1966).

The possibility of checking on the hypothesis concerning C violation of electromagnetic and strong interactions in experiments with high-energy γ quanta and electrons is discussed. (G.O.Y.)

25809 CROSS SECTION FOR PRODUCTION OF CHARGED PIONS IN n-p COLLISIONS AT A NEUTRON EFFECTIVE ENERGY 585 Mev. Basiladze, S. G.; Ermolov, P. F.; Oganesyan, K. O. (Joint Inst. of Nuclear Research, Dubna, USSR). JETP Lett. (USSR)(Engl. Transl.), 3: 103-5(Feb. 15, 1966).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Redakt., 3: 163-6(Feb. 15, 1966).

The cross section for the production of charged pions in n-p interactions with $E_n = 585$ Mev was measured using a scintillation telescope placed at 90° to the neutron beam. The cross section obtained was in agreement with those obtained previously. (G.O.Y.)

25810 CONCERNING THE POSSIBLE ROLE PLAYED BY GRAVITATION IN THE PROBLEM OF THE MASS OF AN ELEMENTARY PARTICLE. Fomin, P. I. (Physico-Technical Inst., Academy of Sciences, Ukrainian SSR). JETP Lett. (USSR)(Engl. Transl.), 3: 120-2(Feb. 15, 1966). Translated from Zh. Eksp. Teor. Fiz., Pis'ma Redkat., 3: 190-2(Feb. 15, 1966).

A length unit is constructed by using the gravitational constant γ; and it is applied, following the dynamic model of elementary particles proposed by Nambu and Jona-Lasinio, to the electromagnetic interaction in terms of which the masses of the electron and the muon are expressed. (G.O.Y.)

25811 OBSERVATION OF CHARGED ρ-MESON AND ITS PROPERTIES USING A MISSING-MASS SPECTROMETER. Blieden, H. R.; Freytag, D.; Geibel, J.; Hassan, A. R. F.; Kienzle, W.; Lefebvres, F.; Levrat, B.; Maglic, B. C.; Seguinot, J.; Smith, A. J. (CERN, Geneva). Nuovo Cimento (10), 43A: 71-83(May 1, 1966).

The mass spectrum of charged bosons is presented in the mass region (650 to 850) Mev, obtained with a missing-mass spectrometer (MMS) operating on the principle of Jacobian peaks in angular distribution. The unstable bosons, x^-, are produced in reaction $\pi^- + p \rightarrow p + x^-$ at incident momenta $p_1 = (3.0 \pm 0.1)$, (3.5 ± 0.1), (4.5 ± 0.045) and (5.05 ± 0.05) Bev/c. (auth)

25812 $U_3 \times U_3$ SYMMETRY FOR COLLINEAR PROCESSES. Ruegg, H.; Volkov, D. V. (CERN, Geneva). Nuovo Cimento (10), 43A: 84-90(May 1, 1966).

Some implications of $U_3 \times U_3$ symmetry for forward and backward scattering of spin-$\frac{1}{2}$ baryons and pseudoscalar mesons are discussed. The $U_3 \times U_3$ group which is considered, is the smallest group which combines SU_3 and spin, and which commutes with a Lorentz transformation along a given direction. A linear combination of the Johnson-Treiman relation still holds, as well as the relation $(\frac{1}{4})\sigma(K^-p \rightarrow K^+\Xi^-) = \sigma(\pi^-p \rightarrow K^+\Sigma^-) = \sigma(K^-p \rightarrow K^0\Xi^0) = \sigma(K^-p \rightarrow \pi^+\Sigma^-)$ for the scattering cross section in forward and backward direction. (auth)

25813 PRODUCTION OF DEUTERONS AND TRITONS IN HIGH-ENERGY PROTON AND PION INTERACTIONS WITH EMULSION NUCLEI. Kamal, A. A.; Rao, G. K.; Rao, L. S.; Rao, Y. V.; Rukmini, B. K. (Osmania Univ., Hyderabad, India). Nuovo Cimento (10), 43A: 91-9(May 1, 1966).

From the analysis of medium-energy particles ($0.41 < \beta < 0.77$) produced in 23 and 24 Bev/c proton interactions with the nuclei of emulsion, 19 deuterons and 4 tritons were identified. At the most 4 deuterons can be attributed to the direct p-N collison with beam protons. In the same velocity interval, a similar analysis from 17 Bev/c π^- interactions yielded 11 deuterons and one triton. Deuteron production cross section in proton interactions is found to be nearly double that in pion interactions in the momentum range investigated. Copious production of deuterons in the low-energy range is explained as due to the pick-up process by the cascade nucleons in the energy band around 600 Mev for which the cross section is known to be appreciable. (auth)

25814 INELASTIC PROTON-PROTON SCATTERING AT 5.10 Gev. Parks, J. G. (Univ. of California, Livermore). Nuovo Cimento (10), 43A: 123-41(May 1, 1966).

Inelastic proton-proton collisions were examined at a bombarding energy of 5.10 Bev using nuclear emulsions. Cross sections and reaction parameters were obtained and compared with the results of experiments at other energies. The scattering data were analyzed in terms of (a) the invariant mass and (b) the effective target mass approach. Phase predictions, based upon approximate solutions of the phase-space integrals and a computer method for obtaining estimates of background, were employed to study the invariant-mass distributions. The adequacy of the effective target mass approach was examined. (auth)

25815 K^+p ELASTIC SCATTERING AT 3.0 Gev/c. Debaisieux, J. (Laboratoire des Hautes Energies, Brussels); Grard, F.; Heughebaert, J.; (and others). Nuovo Cimento (10), 43A: 142-53(May 1, 1966).

In the course of a systematic study of K^+p interactions at 3.0 Bev/c, the elastic-scattering reaction was investigated. A total of 1720 events were identified as elastic scatters, giving a cross section of (4.8 ± 0.4) mb. The angular distribution shows characteristic diffraction peaking and was fitted using $d\sigma/d|t| = (d\sigma/d|t|)_0 \exp[\alpha t + \beta t^2]$, in the momentum-transfer region (0.05 to 1.14) $(Bev/c)^2$. The best fit gave $\alpha = (4.55 \pm 0.39)$ $(Bev/c)^{-2}$ and $\beta = (0.64 \pm 0.42)$ $(Bev/c)^{-4}$. The extrapolated experimental cross section at 0°, $(d\sigma/dt)_0$, is found to be (19.5 ± 2.3) mb/$(Bev/c)^2$, and exceeds the optical theorem prediction by (3.8 ± 2.3) mb/$(Bev/c)^2$, implying that there is a contribution from the real part of the K^+p scattering amplitude at 3.0 Bev/c. (auth)

25816 NORMALIZATION OF BETHE-SALPETER AMPLITUDE AND COUPLING CONSTANTS. Yamazaki, K. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). Nuovo Cimento (10), 43A: 154-60(May 1, 1966).

The coupling constant formula (previously derived by Yamazaki, Dhar, and Katayama) was obtained in a more straightforward manner for the baryon-meson interaction in the nonlinear spinor theory. The derivation makes use of the normalization condition for the Bethe-Salpeter amplitude in the conventional field theory. (auth)

25817 NUCLEON MAGNETIC MOMENTS AND PHOTOPRODUCTION SUM RULES. Fubini, S. (Univ., Turin); Rossetti,; C.; Furlan, F. Nuovo Cimento (10), 43A: 161-70(May 1, 1966).

Dispersion sum rules for the nucleon anomalous magnetic moments are derived in the framework of the vector-axial vector current algebra. The magnetic moments are obtained through dispersive integrals over photoproduction amplitudes. Explicit evaluation of the sum rules shows good agreement with experimental data. (auth)

25818 THE RELATION BETWEEN W-MESON PRODUCTION AND CHARGED LEPTON PAIR CREATION BY HADRON-HADRON COLLISIONS. Yamaguchi, Y. (CERN, Geneva). Nuovo Cimento (10), 43A: 193-9(May 1, 1966).

The relation is discussed between leptons from weak vector bosons (W) and charged lepton pairs from virtual rays, both produced by a hadron-hadron collision. The argument is based on the hypothesis of the conserved weak vector current for weak couplings. It is shown generally that the existence of W could hardly be established by presently available high-energy machines, as long as detection of individual energetic muons is made (because of dominance of muons from γ's over those from W's). (auth)

25819 CURRENT COMMUTATION RELATIONS AND NEW EQUALITIES CONNECTING f_-^K/f_+^K WITH CABIBBO ANGLES. Iwasaki, Y.; Matsuda, S.; Nakamura, K. (Tokyo Univ.). Nuovo Cimento (10), 43A: 210-13(May 1, 1966).

It is shown that application of the current commutation relations, together with the hypothesis of a partially conserved axial-vector current, leads to two new quantities that allow the renormalizations of the $|\Delta S| = 1$ vector and axial-vector currents for the K_{13} and K_{12} decays, respectively, to be expressed in terms of the quantity $\zeta = f_-^K/f_+^K$. The present experimental data give strong support to the validity of these equalities. (L.B.S.)

25820 ON THE CORRECTION TO THE GELL-MANN-OKUBO BARYON LINEAR MASS FORMULA. Boiti, M.; Rebbi, C. (Univ., Turin). Nuovo Cimento (10), 43A: 214-18(May 1, 1966).

The corrections to the Gell-Mann-Okubo baryon linear mass formula are discussed using a method proposed by Fubini, Furlan, and Rossetti. It is shown that the correction depends on known mass differences and on the ratio between the baryon-baryon-spurion and baryon-resonance-spurion coupling constants. (L.B.S.)

25821 GRAPHICAL METHOD FOR STUDYING CONSEQUENCES OF CHARGE INDEPENDENCE IN STRONG INTERACTIONS. Toernqvist, N. A. (Univ. of Stockholm). Nuovo Cimento (10), 43A: 225-6(May 1, 1966).

A graphical method is presented for studying charge independence in particle reactions that can proceed only through two isospin channels but through several charge channels. The reaction $K^+p \rightarrow KN\pi$ is considered as an example. By plotting the branching ratios at different values of various parameters such as energy, momentum transfer etc., isospin properties of intermediate states can be studied. (L.B.S.)

25822 LEPTONIC VS. HADRONIC QUARKS. Massam, T.; Zichichi, A. (CERN, Geneva). Nuovo Cimento (10), 43A: 227-9(May 1, 1966).

It is pointed out that the discovery of hadronic quarks would leave the lepton problem totally unsolved, since in the unitary-symmetry scheme the leptons remain completely isolated. Speculations are made on the analogy that the basis of the "hadronic world" is the hadronic quarks, the basis of the "leptonic world" is the leptonic quarks. It is suggested that a search for fractionally charged leptons could be made along one of the following lines: pair production in electron-position colliding-beam machines, according to the reaction $e^+ + e^- \rightarrow \bar{q}_e + q_e$; and pair production by high-energy photons, according to the reaction $\gamma + N \rightarrow q_e + \bar{q}_e + N'$. (L.B.S.)

25823 DOPPLER WIDTH OF THE ANNIHILATION LINE FROM POSITRONS STOPPED IN OXYGEN. Brimhall, J. E.; Page, L. A. (Univ. of Pittsburgh). Nuovo Cimento (10), 43B: 119 29(May 11, 1966).

The Doppler-broadened portion of the 511-kev annihilation line in oxygen was measured with a germanium detector to have an rms width (1.27 ± 0.11) kev, which is consistent with the angular width deduced from two-quantum angular correlation work. (auth)

25824 EFFECT OF AN ELECTRIC FIELD ON POSITRONIUM FORMATION IN LIQUID ^{4}He. Manuzio, G. E.; Rizzuto, C. (Univ., Genoa. Istituto Nazionale di Fisica Nucleare, Genoa). Nuovo Cimento (10), 43B: 166-9(May 11, 1966).

The effect of a static electric field on the positronium formation in liquid helium was investigated. The experimental results are found to be well reproduced by calculations done for gaseous helium. The similarity of the effects in liquid He and in He gas is also indicated by the identity of the lower limit of Ore's gap. (auth)

25825 HIGH ENERGY BEHAVIOR OF THE πN FORWARD CHARGE-EXCHANGE SCATTERING AMPLITUDE. Hoehler, G.; Baacke, J.; Strauss, R. (Technische Hochschule, Karlsruhe, Ger.). Phys. Lett., 21: 223-7(May 1, 1966).

The dispersion relation is compatible with all charge-exchange forward cross sections up to 18 Bev/c and a Regge-type high energy behavior. The sign of the real part as deduced from the Coulomb interference experiment leads to a serious difficulty. (auth)

25826 POLARIZATION OF RECOIL PROTONS IN PROTON COMPTON SCATTERING AT 720 Mev. Minami, S. (Osaka City Univ.). Phys. Lett., 21: 227-9(May 1, 1966).

It is pointed out that polarization measurements on proton Compton scattering at about 720 Mev give important information concerning the possible resonant states S_{11} and P_{11}. (auth)

25827 DETERMINATION OF NAK COUPLING CONSTANT FROM KN DISPERSION RELATIONS. Lusignoli, M.; Restignoli, M.; Snow, G. A.; Violini, G. (Univ., Rome). Phys. Lett., 21: 229-31(May 1, 1966).

Using forward dispersion relations for KN scattering the value of g^2_{NAK} was determined, as well as an upper limit for g^2_{NEK}. These results are incompatible with SU(3) invariance. (auth)

25828 P-WAVE NON-LEPTONIC DECAYS OF HYPERONS IN SU(6) AND REPRESENTATION MIXING. Santhanam, T. S. (International Centre for Theoretical Physics, Trieste, Italy). Phys. Lett., 21: 234-5(May 1, 1966).

Assuming that the final baryon in the parity-conserving non-leptonic hyperon decays belongs to the completely antisymmetric representation [20], it is shown that $B(\Sigma^-) = 0$ without assuming anything else. (auth)

25829 ELASTIC Σ^+p SCATTERING AT LOW MOMENTA. Dosch, H. G.; Engelmann, R.; Filthuth, H.; Hepp, V.; Kluge, E. (Univ., Heidelberg). Phys. Lett., 21: 236-8(May 1, 1966).

Elastic Σ^+p scattering cross sections and angular distributions are given in the momentum interval of 135-175 Mev/c. (auth)

25830 THE DECAY $K^0_2 \rightarrow \pi^+\pi^-\pi^0$. Hawkins, C. J. B. (Yale Univ., New Haven). Phys. Lett., 21: 238-40(May 1, 1966).

The neutral and charged pion energy spectra for a pure sample of decays $K^0_2 \rightarrow \pi^+\pi^-\pi^0$ are in excellent agreement with a squared matrix element $|M|^2 \propto 1 + \alpha T_0/M_K$ where T_0 is the π^0 kinetic energy and $\alpha = -8.6 \pm 0.07$. The branching ratio $(K^0_2 \rightarrow \pi^+\pi^-\pi^0)/(K^0_2 \rightarrow \text{charged})$ is given as 16.2 + 1.5%. (auth)

25831 EXTENDED ELECTROMAGNETIC STRUCTURE EFFECTS ON LOW-ENERGY PROTON-PROTON SCATTERING. Slobodrian, R. J. (Univ. of California, Berkeley). Phys. Rev., 145: 766-71(May 20, 1966). (UCRL-16322).

The corrections to low-energy $^1S_0$ p-p scattering parameters, arising from the extended electromagnetic structure of the proton, are calculated in the context of nuclear-interaction models without a static core, with a soft core, and also with a hard core of radius $r_c = 0.40$ F. A comparison of the corrected $^1S_0$ p-p scattering length "neutralized" with an approximate formula $(a_p)^n$ is made with the $^1S_0$ n-n scattering length a_{nn} recently determined by reliable experimental methods with reasonable accuracy. (auth)

25832 ELECTROSTATIC EFFECTS IN NUCLEON-NUCLEON SCATTERING AT INTERMEDIATE ENERGIES. Seamon, R. E.; Friedman, K. A.; Breit, G. (Yale Univ., New Haven). Phys. Rev., 145: 779-86(May 20, 1966). (YALE-1807-31).

Making use of a local static potential model of the nucleon-nucleon interaction, estimates are made of the effect of the electrostatic interaction on tests of long-range charge independence, with special reference to data analyses in which the I = 1 phase shifts are assumed to be the same in p-p and n-p scattering at bombarding energies above 10 Mev. The major effect found is caused by a combination of the changes in the expected values of the observables produced by the changes in the phase-parameters of the searched low-L set of I = 1 phases, and the associated shifts of the I = 0 phase-parameters of the searched low-L set that result from their adjustment to compensate for the change of the I = 1 set that is caused by the Coulomb corrections when a minimum of x^2 is looked for. These effects cause an increase in the pion-nucleon coupling constant derived from n-p scattering on the basis of the YRB1(K_0), YLAN4M searches by 5 to 7%, depending on details of the calculations. The violation of charge independence known to exist at very low energies in the $^1S_0$ state, when extrapolated to the 10-350 Mev energy range for that state by means of the model, reduces the above change by roughly 1% of g^2_0. The direct effect of the Coulomb corrections on the one-pion-exchange (OPE) set of phases in p-p scattering is to increase $(g^2_0)_{p-p}$ by an amount estimated not to be greater than 1% of g^2_0. The values of $(g^2_0)_{p-p}$ and $(g^2_0)_{n-p}$ obtained in Yale searches of the YRB1(K_0), YLAN4M series come closer together by about 3 or 4% of g^2_0 as a result of the combined effect of corrections mentioned. Electrostatic corrections of p-p phase-parameters give values of the total scattering cross section σ_{n-n} on the assumption of charge symmetry of nucleon-nucleon forces; these values are compared with recent measurements of Measday and Palmieri. The applicability of multiple-scattering corrections of Glauber to n-D scattering at the relatively low energies of the experiments is briefly discussed. In view of the uncertainties in these as well as in the electrostatic corrections, there appears to be no reason for doubting charge symmetry. On account of

the schematic character of the model used, all of the electrostatic corrections reported here have qualitative significance only, having been intended for general orientation only. (auth)

25833 CLUSTER-MODEL CALCULATION FOR PHASE SHIFTS OF α-α SCATTERING. Okai, Sueji (Florida State Univ., Tallahassee); Park, Shim C. Phys. Rev., 145: 787-93(May 20, 1966).

In the framework of the binary alpha cluster model, phase shifts for s, d, g, i, and k partial waves for α-α scattering are calculated through the excitation energy of 40 Mev. These are compared with recent experiments that appear to suggest the existence of the rotational states with $J^\pi = 6^+$, 8^+ of the nucleus ^{8}Be, beyond the lowest three states with $J^\pi = 0^+$, 2^+, and 4^+. A reasonable agreement is obtained between the calculated phase shifts and the real part of the experimental ones. The present result is also compared with the phase shifts obtained by the phenomenological α-α two-body potential models. A detailed analysis shows that the angular-momentum-dependent but energy-independent core radii of the two-body potential models coincide with the outermost nodes of the scattering functions within the contact distance of two α nuclei. The wave functions within the contact distance do not vanish, however, and hence the repulsive core in a literal sense does not exist. This result is examined in reference to the cluster structure of the ^{8}Be compound nucleus. (auth)

25834 EXPERIMENTAL STUDY OF p + p → p + N* AT INCIDENT ENERGIES OF 6 TO 30 Bev. Anderson, E. W.; Bleser, E. J.; Collins, G. B.; (and others). Brookhaven National Lab., Upton, N. Y.). Phys. Rev. Lett., 16: 855-60(May 9, 1966). (BNL-10136).

Preliminary results are presented of a study of inelastic proton-proton scattering at incident momenta of 6, 10, 15, 20, and 30 Bev/c and squared four-momentum transfers $|t|$ of 0.04 to 5 $|\text{Bev/c}|^2$. The objective of this study was to obtain both detailed information and a qualitative understanding of the behavior of inelastic channels at high energy. Differential cross sections were obtained for the different p + p → p + N* processes. (B.G.D.)

25835 ANGULAR DISTRIBUTION OF THE π^0 IN THE REACTION $\pi^+ + p \rightarrow \pi^+ + p + \pi^0$ UP TO 1070 Mev. Detoeuf, J. F.; Ducros, Y.; Merlo, J. P.; Stirling, A. V.; Thevenet, B.; van Rossum, L.; Zsembery, J. (Centre d'Etudes Nucleaires, Saclay, France). Phys, Rev. Lett., 16: 860-3 (May 9, 1966).

A description is presented on the experimental arrangement and the principle of analysis of the results in a previous investigation concerning the total cross section of the process $\pi^+ + p \rightarrow \pi^+ + p\,\pi^0$. The experimental results of cross sections up to the third order fit and π^0 angular distributions are presented for incident pion energies of 420 to 1070 Mev. (B.G.D.)

25836 ANGULAR DISTRIBUTION OF THE π^0 IN THE REACTION $\pi^+ + p \rightarrow N_{1238}^{*++} + \pi^0$ FROM 0.5 TO 1.46 Gev. Kraybill, H. L. (Yale Univ., New Haven); Stonehill, D. L.; Deler, B.; Laskar, W.; Merlo, J. P.; Valladas, G.; Tautfest, G. W. Phys. Rev. Lett., 16: 863-9(May 9, 1966).

In view of a two-body partial-wave analysis of the reaction $\pi^+ + p \rightarrow \pi^0 + N_{1238}^*$ recent bubble chamber results from Purdue, Saclay, and Yale concerning angular distribution of the π^0 associated with a π^+p mass 1.23 ± 0.07 Bev/c^2 at incident energies from 0.81 to 1.30 Bev are presented. The results of each experiment are expressed by a distribution of the production cross section into 20 intervals of the cosine of an angle θ between the incident pion and the π^0 in the overall center of mass. (B.G.D.)

25837 CABIBBO'S ANGLE AND THE RATIO $\Gamma(K \rightarrow \mu + \nu)/\Gamma(\pi \rightarrow \mu + \nu)$. Sirlin, A. (New York Univ., New York). Phys. Rev. Lett., 16: 872-4(May 9, 1966).

In the decays $\pi \rightarrow \mu + \nu$ and $K \rightarrow \mu + \nu$, it is shown that the ratio $\Gamma(K \rightarrow \mu + \nu)/\Gamma(\pi \rightarrow \mu + \nu)$ is proportional to $\tan^2\theta_A$ (a_K^2/a_π^2), where θ_A is the axial-vector angle and the coupling a_π is defined by $\langle 0|J_{5\mu}^{\pi-}|\pi^+(k)\rangle = a_\pi k_\mu/(2k_0)^{\frac{1}{2}}$ and a_K is defined by an analogous expression. An evaluation of a_K/a_π is attempted based on the SU(3) algebra of the vector and axial vector charges, the partially-conserved-axial-vector current (PCAC) hypothesis, and the approximation of retaining only the lowest mass states of the discrete spectrum in suitable sums over intermediate states. (B.G.D.)

25838 NONLEPTONIC DECAYS OF K MESONS. Hara, Yasuo (Inst. for Advanced Study, Princeton, N. J.); Nambu, Yoichiro. Phys. Rev. Lett., 16: 875-9(May 9, 1966).

The techniques of current commutation relations based on the quark model and the notion of a partially conserved axial vector current (PCAC) which lead to predictions about both s- and p-wave amplitudes are applied to the nonleptonic decays of K mesons. (B.G.D.)

25839 CURRENT-COMMUTATOR THEORY OF MULTIPLE PION PRODUCTION. Weinberg, Steven (Univ. of California, Berkeley). Phys. Rev. Lett., 16: 879-83(May 9, 1966).

The partially conserved axial-vector current (PCAC) assumption, together with the current-commutation relations are discussed in regards to the calculation of the matrix elements for emission of any number of soft pions in an arbitrary process. (B.G.D.)

25840 ANOMALOUS MASS OF THE MUON AND LARGE MASS OF THE INTERMEDIATE WEAK BOSON. Kitazoe, Tetsuro (Osaka Univ.). Progr. Theoret. Phys. (Kyoto), 35: 288-303(Feb. 1966).

In order to introduce a mechanism to induce the anomalous muon mass, a quadratic strong interaction between the intermediary weak boson and the muon is proposed. By taking account of the lepton-baryon symmetry, the same quadratic interaction between the weak boson and the strange particles is introduced. It is assumed that it is responsible for the breakdown of the SU(3) symmetries in hadrons. This interaction scheme is found to be consistent with experiment. It is concluded that the large mass of the weak boson is naturally obtainable. As a consequence of the interactions, the shift of the muon's g factor from the purely electromagnetic one is found to be $\sim 4 \times 10^{-6}$. Experimental tests of the interaction are discussed and the branching ratios of the decays $K^{(\pm 0)} \rightarrow \pi^{(\pm 0)}\,\mu^+\mu^-$ and $K_1^0 \rightarrow \mu^+\mu^-$ are evaluated. (auth)

25841 PARITY CONSERVATION IN THE STRONG INTERACTIONS. Sakuma, Tetsuro (Hokkaido Univ., Sapporo); Tokuda, Naoki. Progr. Theoret. Phys. (Kyoto), 35: 331-3(Feb. 1966).

It is noted that parity conservation in the meson (π)-nucleon interaction can result from the dynamical self-consistency requirement on the meson (π)-nucleon vertex which was previously proposed for the weak interaction. It is also noted that the result gives a somewhat stronger restriction on the meson (π)-nucleon interaction than that of previous work. It is found that conservation in this interaction can be obtained by the dynamical self-consistency requirement shown both for the isovector and isoscalar mesons (π). The self-consistent solution exists for the isovector-pseudoscalar and for the isoscalar-scalar meson (π), and a reasonable magnitude of the meson (π)-nucleon coupling constant can also be derived for the case of an isovector meson (π). (J.F.P.)

25842 PION-PION INTERACTION. Furuichi, Susumu (Rikkyo Univ., Tokyo); Kanada, Hiroyuki; Watanabe, Keiji. Progr. Theoret. Phys. (Kyoto), 35: 333-4 (Feb. 1966).

The two-meson (π) state is investigated in order to clarify the meson (π)-meson (π) correlation effect in the two-meson (π)-exchange contribution in various processes. The formula for fixing the p-wave resonance with the meson (ρ) mass and width is refined, and its solution investigated. (J.F.P.)

25843 A MODEL OF PSEUDOSCALAR MESONS WITH THE $Z_3 = 0$. Hayashi, Kenji; Shirafuji, Takeshi (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), 35: 337-9(Feb. 1966).

The meson (K) problem is considered in terms of meson (K*)-meson (π) interactions under the requirement that

$Z_3 = 0$. Also the idea that the pseudoscalar mesons, especially their behavior at low energy, are well described by the P-V models with vector and possibly tensor exchange forces is supported. (J.F.P.)

25844 RANDOM TRIAL METHOD FOR SIMULATING CONDITIONS OF RECORDING AND IDENTIFICATION OF K_2^0 DECAYS IN WILSON CHAMBER. I. THE METHOD FOR SELECTIVE STATISTICAL ACCUMULATION OF VIRTUAL V^0 EVENTS. Neagu, D. V. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys., 11: 57-82(1966).

A general method for the construction of a statistical box which contains selected events from the possible meson (K_2^0) decays is described. The selection conditions correspond to registration and identification conditions for these events formulated in terms of channels which select from the general combined events those which correspond to experimental conditions. The algorithms which allow programming for computer operations are described. (tr-auth)

25845 RANDOM TRIAL METHOD FOR SIMULATING CONDITIONS OF RECORDING AND IDENTIFICATION OF K_2^0-DECAYS IN WILSON CHAMBERS. II. SELECTED STATISTICAL EVENTS AND THEIR APPLICATIONS. Neagu, D. V. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys., 11: 83-96(1966).

With the help of the channels described previously which select from the whole general group the meson (K_2^0) decays which satisfy real experimental conditions, calculation programs for the selection of events in two cases are described: the identification of decay particles made by the method of measuring the impulse channel for passage through a lead filter; and the identification of particles made by the method of measuring the blackening of the photographic track image. The problem of the energy-spectra determination of the incident flux of mesons (K_2^0) is determined using the same program. (tr-auth)

25846 DETERMINATION OF BRANCHING RATIOS. Meyer, Stuart L. (Rutgers Univ., New Brunswick, N. J.). Rev. Sci. Instrum., 37: 662-3(May 1966).

The efficiency of film scanning in the determination of branching ratios is discussed with consideration of the number of scans that should be performed on a given film. (D.C.W.)

25847 THEORY AND EXPERIMENTATION OF THE MOTION ZONE OF CHARGED PARTICLES IN MAGNETIC FIELDS. Hsu, Jung-lan; Chou, Kuo-cheng. Ti Ch'iu Wu Li Hsueh Pao, 12: 121-30(1963).

The motion zone of a charged particle in an electromagnetic field is studied. In the calculational process, potential is assumed to exist across the magnetic field, and the potential function is considered to possess axial symmetry and to be a plane function. The results indicate that when the magnetic field is strong enough, the boundary of the charged-particle's motion zone is similar to the magnetic lines. This means the motion zone of a charged particle can be determined by a map of magnetic lines of force. When tested with experiments, the following observations are obtained: In the presence of a dipole field with magnetic moment approaching its critical value, discharge glow is captured by the dipole magnetic field; thus, its boundary follows the magnetic lines. In the case when the dipole magnetic field is disturbed by two external magnetic fields, both in the equational plane, one is a homogeneous magnetic field opposite in direction to the dipole field in the equational plane and the other is a toroidal field in the equational plane, the magnetic lines of force of the original dipole field will extend outward. The results show that the discharge glow expands in the same fashion, and the glow boundary undergoes similar change as the magnetic lines. Calculated illuminating area from discharge glow basically agrees with the experimental findings. (ATD)

25848 TRANSITION RADIATION AND OPTICAL PROPERTIES OF MATTER. Frank, I. M. Usp. Fiz. Nauk, 87: 189-210(Oct. 1965). (In Russian).

The literature is reviewed to give a general picture of the state of the art in transition radiation and the optical properties of matter. The theoretical basis for transition radiation is outlined and various formulas are given for calculating the spectral density of radiation. Experimental data are reviewed on radiation in the optical region of the spectrum from various elements under the activating effect of electrons. The factors determining radiation yield are discussed. The particular features of transition radiation of relativistic particles in the optical region of the spectrum are considered. A brief survey of some of the recent results of research on the Cherenkov effect is also given. (ATD)

25849 HYPERON PAIR ANNIHILATION OF $p\bar{p}$ AND SU(3) SYMMETRY. Liu, Lian-sou (Peking Univ.). Wu Li Hsueh Pao, 22: 146-51(Feb. 1966). (In Chinese).

The hyperon pair annihilation of $p\bar{p}$ is treated by means of the pole approximation and a broken SU(3) symmetry. There are two sources of symmetry breaking: mass differences and a factor inversely proportional to the meson mass at each vertex. The calculated angular distribution and branching ratio fit the experimental data. (auth)

25850 ON THE ISOTOPIC VECTOR ELECTRIC AND MAGNETIC FORM FACTORS OF THE NUCLEONS. Tsao, Chang-chie; Tsu, Yung-lon; Wang, Su-sen (Peking Univ.). Wu Li Hsueh Pao, 22: 152-62(Feb. 1966). (In Chinese).

The subtraction in the dispersion relations for $G_i(t)$ and $\Gamma_i(t)$ is discussed in reference to a theorem proved by Sugawara and Kanazawa together with recent studies of asymptotic behavior by Omnes. The contributions to the $\Gamma_i(t)$ and $F_\pi(t)$ by the far away singularities are accounted for carefully; the results agree fairly well with both the electric and magnetic isotopic vector form factors; the $\Gamma_i(t)$ satisfies the requirement proposed by Vick from the analysis of $\pi - N$ scattering data. The calculation also shows that the total isotopic vector charge and magnetic moment are mainly due to the 2π intermediate state contribution; it is very probable that there exist no core point charge and magnetic moment at all. (auth)

25851 RADIATIVE PION-NUCLEON SCATTERING AND THE $\gamma 3\pi$ INTERACTION. Bulychev, Yu. P.; Radutskii, G. M.; Serdyutskii, V. A. (Tomsk Polytechnic Inst., USSR). Yadern. Fiz., 3: 495-8(Mar. 1966). (In Russian).

The role of the $\gamma 3\pi$ interaction in the $\pi^- + p \rightarrow \pi^- + p + \gamma$ reaction at energies near to the (3,3) resonance is discussed. A statistic theory is used, switching on the (3,3)-resonance interaction in the final state. The $s \rightarrow pE1$ transition is supposed to dominate. The nucleon and meson currents are neglected. It is shown that a significant contribution of the $\gamma 3\pi$-interaction is necessary to explain the magnitude of the reaction cross section. (auth)

25852 SINGLE-PHOTON ANNIHILATION OF POLARIZED ELECTRON-POSITRON PAIRS IN A MAGNETIC FIELD. Ternov, I. M.; Korovina, L. I.; Pavlova, O. S. (Moscow State Univ.). Yadern. Fiz., 3: 499-502(Mar. 1966). (In Russian).

The influence of the electron- and positron-spin orientation on the probability of their annihilation in a magnetic field is investigated. It is shown the annihilation probability decreases, if the electron spin is opposite to the positron spin and to the direction of the magnetic field. (auth)

25853 INVESTIGATION OF THE REACTION $\pi^- + p \rightarrow \pi^- + \gamma + p$ AT 338 Mev. Blokhintseva, T. D.; Grebinnik, V. G.; Zhukov, V. A.; Libman, G.; Nemenov, L. L.; Selivanov, G. I.; Yuan, Jung-fang (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 3: 511-20(Mar. 1966). (In Russian).

An analysis of 84 events indicates the constant for photon production in $\pi^- + p$ interactions is 0.5 ± 0.3. (J.F.P.)

25854 INFLUENCE OF DEUTERON INTERNAL STRUCTURE ON DIFFRACTION SCATTERING. Sitenko, A. G.; Berezhnoi, Yu. A.; Evlanov, M. V. (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Yadern. Fiz., 3: 521-5(Mar. 1966). (In Russian).

The influence of the finite radius of the neutron-proton nuclear interactions in the deuteron and of the deuteron internal structure, on the magnitudes of the integral cross sections of various diffraction interactions between deuter-

ons and nuclei, and on the differential cross section for elastic deuteron scattering, is considered. (auth)

25855 BARYON ANNIHILATION IN BROKEN $\tilde{U}(12)$) SYMMETRY. Vinternitz, P.; Makarov, A. A.; Nguyen Van Hieu; Tkachev, L. G.; Uglirzh, M. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 3: 541-4(Mar. 1966). (In Russian).

The cross sections of the annihilations $p + \bar{p} \rightarrow M + M$ and $n + \bar{p} \rightarrow M + M$ into pseudoscalar and vector mesons are predicted on the basis of the intrinsically broken $\tilde{U}(12)$ symmetry, taking all possible invariant amplitudes into account. (auth)

25856 FORM FACTORS IN NON-LEPTONIC DECAYS AND REACTIONS PRODUCING W BOSONS. Okun', L. (Inst. of Theoretical and Experimental Physics, State Atomic Energy Commission, USSR). Yadern. Fiz., 3: 590-1(Mar. 1966). (In Russian).

Results of previous studies are used to show that (1) decays of intermediate bosons into hadrons (mesons and baryon-antibaryon pairs) may prove to be substantially less probable than decays into leptons ($W \rightarrow \mu\nu$ and $W \rightarrow e\nu$); (2) the cross sections for W-boson formation in collisions of nucleons or mesons with nucleons and nuclei may be significantly less than is usually assumed; and (3) in establishing a lower limit for the W-boson mass by means of studying these processes, it is meaningful to consider the boson production cross section relative to the electromagnetic formation cross section of the pairs e^+e^- and $\mu^+\mu^-$ arising in these processes as a result of internal conversion and processing mass of the order of the unknown mass of the W boson. (M.J.T.)

25857 INELASTIC SCATTERING OF MODULATED RADIATION. Varshalovich, D. A. (Ioffe Inst. of Physics and Tech., Leningrad). Yadern. Fiz., 3: 643-6(Apr. 1966). (In Russian).

It is shown that the modulation of a modulated radiation is conserved in inelastic scattering, if the scattering atom or electron are not detected. The modulation depth and phase of the modulating signal are practically the same in the incident and scattered wave, except for the case of resonance scattering. In particular, the slowing down of α-particles should not disturb the α-radiation modulation, although the lines in the α-spectrum are considerably widened. The modulation depth can increase in resonance scattering. (auth)

25858 DIRECT PRODUCTION OF LEPTON PAIRS BY A NEUTRINO BEAM IN THE ELECTROMAGNETIC FIELD OF A NUCLEUS. Marinov, M. S.; Nikitin, Yu. P.; Orevkov, Yu. P.; Shabalin, E. P. (Inst. of Theoretical and Experimental Physics, State Atomic Energy Commission, USSR). Yadern. Fiz., 3: 678-86(Apr. 1966). (In Russian).

The cross section of the $\nu + Z \rightarrow \nu + Z + l^+ + l^-$ process in the field of a nucleus, where l is an electron or μ-meson, is calculated with the help of numerical integration. The calculations were performed for neutrino energies up to 50 Bev. The probability of pair production in the existing neutrino beam is about 10^{-5} of the quasielastic direct interaction probability. (auth)

25859 ANALYSIS OF THE REACTIONS $\pi^- + p \rightarrow \pi^- + \pi^+ + n$ AND $\pi^- + p \rightarrow \pi^- + \pi^0 + p$ WITH 338-Mev π^- MESONS. Blokhintseva, T. D.; Grebinnik, V. G.; Zhukov, V. A.; Libman, G.; Nemenov, L. L.; Selivanov, G. I.; Yuan, Jung-fang (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 3: 687-92(Apr. 1966). (In Russian).

The differences of the cross section in the $\pi^- + p \rightarrow \pi^- + \pi^+ + n$ (I) and $\pi^- + p \rightarrow \pi^- + \pi^0 + p$ (II) reactions were determined for the kinetic energy of the π^--mesons 338 Mev. Under the assumption that the isobar transitions occur in the $T = \frac{1}{2}$ state, the total cross section of the reaction (II) is equal to the sum of the isobar channel cross sections within the experimental errors. Under the same assumption the total cross section of the reaction (I) is not described by the sum of the corresponding isobar channel cross sections. The influence of the $\pi\pi$-interaction shows up in the effective mass spectrum of the $\pi^+\pi^-$-system, but not of the $\pi^-\pi^0$ one. The $\frac{3}{2}\,\frac{3}{2}$ isobar influences the angular distribution of secondary particles from reaction (I). (auth)

25860 PLANNING OF np SCATTERING EXPERIMENTS FOR DISCRIMINATION BETWEEN VARIOUS SETS OF PHASE SHIFTS. Legar, F.; Fedorov, V. V. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 3: 693-6(Apr. 1966). (In Russian).

An optimal experiment is planned to discriminate between the sets of phase shifts in np-scattering at 630 Mev. (auth)

25861 ELASTIC SCATTERING OF Λ HYPERONS WITH THE AVERAGE MOMENTUM 2.7 Gev/c ON PROTONS. Vishnevshii, V. F.; Du, Yuan-tsai; Moroz, V. I.; Nikitin, A. V.; Troyan, Yu. A.; Chiang, Shao-chun; Chang, Wen-yu; Shakhbazyan, B. A.; Yen, Wu-kuang (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 3: 697-702(Apr. 1966). (In Russian).

The elastic scattering total cross section of Λ-hyperons with the average momentum $\bar{p}_\Lambda = 2.7 \pm 1.2$ Bev/c on protons is experimentally found to be 15 ± 4 mb. This result is compared with the known theoretical and experimental data. (auth)

25862 MESON CURRENT IN BROKEN $\tilde{U}(12)$ SYMMETRY AND COLLIDING-BEAM EXPERIMENTS. Winternits, P.; Makarov, A. A.; Nguyen Van Hieu; Tkachev, L. G.; Uglirzh, M. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 3: 722-5(Apr. 1966). (In Russian).

The general structure of the matrix element of the meson current in the broken $\tilde{U}(12)$-symmetry is studied. This current is used to calculate the cross sections for meson pair production in experiments with colliding electron-positron beams. (auth)

25863 RECONSTRUCTION OF THE $N + N \rightarrow \pi + d$ REACTION AMPLITUDE. Shekhter, L. Sh. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 3: 739-51(Apr. 1966). (In Russian).

The reconstruction of the $N + N \rightarrow \pi + d$ reaction amplitude for a given energy and scattering angle, is discussed. It is shown that it is necessary to measure the following quantities, so as to reconstruct directly the amplitude up to a common phase-factor: differential cross section for an unpolarized beam and target, left-right asymmetry for a polarized beam, left-right asymmetry for a polarized target, addition to cross section due to various orientations of the beam and target polarizations, deuteron polarization for unpolarized, transversally and longitudinally polarized initial proton beams. (auth)

25864 SELECTION RULES FOR THE ANNIHILATION OF POLARIZED FERMIONS. Khriplovich, I. B. Yadern. Fiz., 3: 762-4(Apr. 1966). (In Russian).

Certain selection rules are obtained for the creation of pseudoscalar mesons in the annihilation of a transversely polarized electron and positron. The invariance of the interaction with respect to the reflection of one of the space axes and the chirality conservation law are used. (auth)

25865 MASS FORMULA IN THE NEUTRAL VECTOR MESON THEORY. Sokolov, V. V. Yadern. Fiz., 3: 765-77(Apr. 1966). (In Russian).

Relations are obtained in the theory of a neutral vector meson, interacting with a conserved current, connecting the meson mass with the spectral functions of both interacting fields. An analysis of these relations makes it possible to draw some conclusions about the charge and mass renormalization constants. (auth)

25866 SPIN EFFECTS IN HIGH-ENERGY NUCLEON-NUCLEON SCATTERING. Kaidalov, A. B.; Karnakov, B. M. (Inst. of Theoretical and Experimental Physics, State Atomic Energy Commission, USSR. Moscow Engineering Physics Inst.). Zh. Eksp. Teor. Fiz., 50: 691-3 (Mar. 1966). (In Russian).

Polarization of finite nucleons in NN-scattering is considered under the assumption that the main singularities in the complex j plane possess definite quantum numbers. An experimental possibility is mentioned for checking the

hypothesis that the vacuum state determines the behavior of the scattering amplitude at high energies. (auth)

25867 ZERO SOUND OSCILLATIONS IN A SYSTEM OF INTERACTING BOSE AND FERMI PARTICLES. Badalyan, A. M.; Maksimov, L. A. Zh. Eksp. Teor. Fiz., 50: 783-90 (Mar. 1966). (In Russian).

It is shown that the interaction between Fermi and Bose particles can lead to the appearance of a new excitation sound branch in the Bose system. The velocity of propagation of the branch and its anisotropy depend on the shape of the Fermi surface. (auth)

25868 ANGULAR DISTRIBUTION OF BREMSSTRAHLUNG RADIATION AND THE LANDAU-POMERANCHUK EFFECT. Kalashnikov, N. P.; Ryazanov, M. I. (Moscow Engineering Physics Inst.). Zh. Eksp. Teor. Fiz., 50: 791-4(Mar. 1966). (In Russian).

The effect of multiple scattering on the direction and frequency distribution of bremsstrahlung radiation is considered. It is shown that in the range in which the Landau–Pomeranchuk effect is encountered multiple scattering diminishes the radiation intensity at small angles but does not affect the large angle radiation. This agrees with the results of a qualitative treatment. Integration of the formula derived leads to the results obtained by Landau, Pomeranchuk and Migdal. (auth)

25869 AN ELEMENTARY DISCUSSION OF POSSIBLE NON-INVARIANCE UNDER T, CP, AND CPT IN HYPERON DECAYS. Lee, T. D. (Columbia Univ., New York). pp 5-16 of Preludes in Theoretical Physics. Amsterdam, North-Holland Publishing Co., 1966. (TID–21820).

A review of underlying theoretical arguments on tests of invariance to separate out the various implications of different symmetry requirements is presented. Analysis of the decay of a spin $\frac{1}{2}$ hyperon $\Lambda^0 \rightarrow N + \pi$ where N stands for either p or n and π represents π^- or π^0 is derived. The consequences of possible noninvariance under T, CP, and CPT are derived. The time reversal invariance in the hyperon decay means that the relative phase between the $S_{\frac{1}{2}}$ and $p_{\frac{1}{2}}$ amplitudes is determined by the corresponding strong interaction phase shifts. The same result is obtained by an alternative proof which is based only on the reciprocity relation between different reaction rates, without the use of the time reversal operator T. A simple example is given which illustrates the difference between the consequences of time reversal invariance in quantum mechanics and that in classical mechanics, and which emphasizes again that the present tests of time reversal invariance concern only the reciprocity relations between various cross sections, rather than the detailed time reversal operation T. (B.G.D.)

25870 STRONGLY INTERACTING PARTICLES AND THE TRIPLET HYPOTHESIS. Van Hove, L. (CERN, Geneva). pp 44-50 of Preludes in Theoretical Physics. Amsterdam, North-Holland Publishing Co., 1966.

An intuitive discussion of hadron physics and the triplet hypothesis is presented. Some topics included are the composite and electromagnetic structures of baryons and mesons, weak interactions of hadrons, and the question of symmetries being fundamental. (B.G.D.)

25871 SYSTEMATICS OF HADRONS IN SUBNUCLEAR PHYSICS. Nambu, Yoichiro (Univ. of Chicago). pp 133-42 of Preludes in Theoretical Physics. Amsterdam, North-Holland Publishing Co., 1966. (COO–264-259; EFINS–65-41).

A subnuclear structural model for baryons and mesons is discussed, which is composed of fundamental objects which are heavy ($\gg$1 Bev), though not necessarily stable, and that inside each baryon or meson they are combined with a large binding energy, yet moving with nonrelativistic velocities. (B.G.D.)

25872 CONCEPT OF MAXIMAL CP VIOLATION. Wolfenstein, Lincoln (Carnegie Inst. of Tech., Pittsburgh). pp 170-6 of Preludes in Theoretical Physics. Amsterdam, North-Holland Publishing Co., 1966.

The development of the concept of maximal CP violation defined as similarly as possible to the accepted concept of maximal parity violation is discussed. The discussion is limited to the single process $\pi \rightarrow l + \bar{\nu}$, the decay of a spin-zero meson into two spin-$\frac{1}{2}$ leptons, and the corresponding antiparticle decay $\bar{\pi} \rightarrow \bar{l} + \nu$. (B.G.D.)

25873 BOSON BETA DECAY. Peaslee, D. C. (Australian National Univ., Canberra). pp 192-8 of Preludes in Theoretical Physics. Amsterdam, North-Holland Publishing Co., 1966.

A discussion of leptonic decay of bosons in the closest possible analogy with ordinary beta decay is presented. Each boson is represented as a sum over nuclei composed of N baryons and N antibaryons. The conserved vector current (CVC) hypothesis as equivalent to the super allowed beta decay of nuclei is derived. CVC for $\Delta S = 0$ is then just the well known rule that the Fermi matrix element for superallowed nuclear transitions is unity. No CVC theorem appears when this approach is repeated for $\Delta S \neq 0$; nor is it possible to make general statements about axial vector transitions except with supermultiplets. In this connection, the interest is noted in measuring $K \rightarrow e + \nu + 2\pi$. (B.G.D.)

25874 C VIOLATION IN STRONG INTERACTIONS. Prentki, J. (CERN, Geneva. College de France, Paris); Veltman, M. pp 250-9 of Preludes in Theoretical Physics. Amsterdam, North-Holland Publishing Co., 1966.

An investigation of certain properties that can be attributed to the C violating interaction is presented. The detection of $\Delta I = 0$, C violating interactions are discussed with occasional mention of tests for $\Delta I \neq 0$, C violating interactions. C violating decays of π^0, η, X^0, ρ, ω, and ϕ are considered. The antiproton–proton interaction with copious K and K* production is also discussed. (B.G.D.)

25875 TEST OF ROLE OF STATISTICAL MODEL AT HIGH ENERGIES. Drell, S. D. (Stanford Univ., Calif.); Speiser, D. R.; Weyers, J. pp 294-301 of Preludes in Theoretical Physics. Amsterdam, North-Holland Publishing Co., 1966.

A feasible program is proposed for testing the validity of the statistical model of nuclear reactions in high-energy collisions. The idea presented is to check the very general premise of the statistical model that all channels should contribute with equal probabilities and with random relative phases, independent of more detailed dynamical questions of specific energy or angle variation of the cross sections. Two-body reactions involving incident meson or photon beams meson + baryon $\rightarrow$ meson + baryon and photon + baryon $\rightarrow$ meson + baryon are considered. (B.G.D.)

25876 PION-NUCLEON SCATTERING AND SU(4) SPIN-ISOSPIN SYMMETRY. Cini, M. (Univ., Rome. Istituto Nazionale di Fisica Nucleare, Rome). pp 330-8 of Preludes in Theoretical Physics. Amsterdam, North-Holland Publishing Co., 1966.

An investigation is presented on the extent of Wigner's SU(4) theory of supermultiplets, based on the enlargement to the spin space of the symmetry properties on internal degrees of freedom, in providing information on properties of nonstrange baryons and mesons in comparison with conventional dynamical theory. Some observations on the relation between the conventional treatment of the old problem of pion-nucleon scattering, and its modern version in terms of the SU(4) spin-isospin symmetry group are included. (B.G.D.)

25877 SEMICLASSICAL APPROACH TO THE PERIPHERAL MODEL. Amati, D. (CERN, Geneva. Univ., Modena, Italy). pp 339-46 of Preludes in Theoretical Physics. Amsterdam, North-Holland Publishing Co., 1966.

A semiclassical approach to the peripheral model, which is straightforward and analogous to the Weizsäcker-Williams approach in electrodynamics is presented. This approach is utilized in understanding the collision of the incoming pion against pions of the nucleon cloud, which except for the innermost part consists mainly of pions. The results of the semiclassical and the peripheral approaches are compared. (B.G.D.)

Field Theory, Scattering Theory, and Symmetries

See also Elementary Particles and Radiations

Refer also to abstract 25644.

25878 (DESY-66/7) WHAT IF ANYTHING IS SU(6) SYMMETRY? Stichel, P. (Physikalisches Staatsinstitut, Hamburg (West Germany). Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Mar. 1966. 12p. (CONF-650218-2). Dep. mn.

From International University Sessions on Nuclear Physics, Schladming, Austria.

The violation of some basic physical concepts caused by applying formal group theoretical methods to elementary particle physics is discussed. A critical review of SU(6) symmetry is presented. The basic ideas and the main defects of the different approaches within the SU(6) theory are discussed. The connections between the different approaches which are of a logical, quasi-logical, or nonlogical nature are discussed. (M.O.W.)

25879 (IC–66/30) THE RELATION OF THE O(2,1) PARTIAL WAVE EXPANSION TO THE REGGE REPRESENTATION. Boyce, J. F. (International Centre for Theoretical Physics, Trieste (Italy)). Apr. 1966. 40p. Dep. mn.

The general two-particle scattering amplitude is expanded in terms of partial waves corresponding to the crossed channel little group O(2,1). The invariance of the S-matrix under the complex Lorentz group which follows from the Bargmann-Hall-Wightmann theorem enables this expansion to be identified with the Regge representation in the crossed channel. (auth)

25880 (IC–66/34) UNIVERSAL COUPLING OF VECTOR MESONS REVISITED. Krolikowski, W. (International Centre for Theoretical Physics, Trieste (Italy)). Apr. 1966. 14p. Dep. mn.

It is shown that "the partial conservation of a tensor current" (PCTC) leads to a universality of vector meson interactions, without assuming the Sakurai hypothesis on universal coupling of vector mesons to currents of symmetry generators. Meson electromagnetic decays are discussed on the grounds of PCTC and the results compared with the Sakurai universality. (auth)

25881 (IC–66/35) MASS FORMULAE AND U(6) ⊗ $\bar{U}$(6) MIXING. Cocho, G.; White, R. (International Centre for Theoretical Physics, Trieste (Italy)). Apr. 15, 1966. 8p. Dep. mn.

Particles have been previously considered as belonging to representations of U(6) ⊗ $\bar{U}$(6), where quarks transform according to U(6) and antiquarks according to $\bar{U}$(6). The possibility is considered that the physical particles be given by mixtures of different levels of the U(6) ⊗ $\bar{U}$(6) tower but that the interactions be invariant under U(6) ⊗ $\bar{U}$(6). (M.O.W.)

25882 (IC–66/41) ON THE DYNAMICAL ORIGIN OF SU(6). Delbourgo, R.; Salam, Abdus; Strathdee, J. (International Centre for Theoretical Physics, Trieste (Italy)). Apr. 26, 1966. 7p. Dep. mn.

A relativistic dynamical model is considered for massive quark-antiquark binding which gives rise to the rest symmetry $U(6)_w$ ⊗ O(3) for the meson bound states. The model may or may not be realistic: it does however show how much higher symmetries may emerge from dynamical approximations; it throws some light on the role of noncompact groups and it leads to a definite representation mixing. (M.O.W.)

25883 (IC–66/42) CABIBBO ANGLE AS A RENORMALIZATION EFFECT. Narayanaswamy, P.; Pradhan, T. (International Centre for Theoretical Physics, Trieste (Italy)). Apr. 20, 1966. 10p. Dep. mn.

It is shown that the Cabibbo sin θ factor can be understood as a renormalization effect if one uses the algebra of currents constructed from the phenomenological fields of hadrons to derive sum rules for the axial vector coupling constants in their β-decay. (auth)

25884 (IC–66/44) CURRENT × CURRENT INTERACTION AND $|\Delta I| = \frac{1}{2}$ RULE. Hara, Y. (International Centre for Theoretical Physics, Trieste (Italy)). May 2, 1966. 11p. Dep. mn.

It is shown that the $|\Delta I| = \frac{3}{2}$ amplitudes of hyperon decays are negligible in the limit of zero pion four momentum even if one assumes that the nonleptonic weak interaction is a product of the weak charged current and its hermitian conjugate. (M.O.W.)

25885 (JINR–P-2631) O LOKALIZATSII RELYATIVISTSKIKH MIKROCHASTITS V PROSTRANSTVE I VREMENI. (On a Localization of Relativistic Microparticles in Space Time). Blokhintsev, D. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1966. 15p. Dep. mn.

It is shown that particles may be localized in positive energy states with any degree of accuracy if the quadratically integrable wave packets are considered instead of the eigenfunction of the coordinate operator. (auth)

25886 (NP–15963) LECTURES ON RELATIVISTIC GENERALIZATION OF SU(6). Report No. 44. Ruegg, H. (Institute of Mathematical Science, Madras (India)). [1965]. 107p. Dep. mn.

Twelve lectures are presented on the relativistic generalization of SU(6). Free use was made of standard works on the Poincaré group, especially those of Shirokov and Joos. (M.O.W.)

25887 (PAEC(A)PH–663-a) THE NUCLEAR FORCE EQUATIONS AND THE BOOTSTRAP HYPOTHESIS. Eugenio, Manuel R.; Davila, Aida T. (Philippine Atomic Energy Commission, Manila). May 1966. 4p. Dep. mn.

The relationships between nuclear force (or field) and nuclear mass are given. The relationships between nuclear binding energy (or potential) and nuclear mass are given. The nuclear forces and positive potentials are plotted against mass number A and compared. (M.O.W.)

25888 (PUC–937-201) SUPERMULTIPLET THEORY. Flores, J. A. (Princeton Univ., N. J. Palmer Physical Lab.). Jan. 1966. Contract AT(30-1)-937. 29p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

A second-quantization formulation of the many-body problem and its group theoretical interpretation are described. A detailed discussion on supermultiplet classification of states is presented. As a final application of supermultiplet theory, eigenvalues of the exchange operators were obtained. (M.O.W.)

25889 (RHEL/R–108) LECTURES ON ELEMENTARY SCATTERING THEORY. Given at the University of Bristol, During Spring, 1965. Jones, D. P. (National Inst. for Research in Nuclear Science, Chilton (England). Rutherford High Energy Lab.). Dec. 1965. 52p. Dep. mn. BIS $1.60. HMSO 8s.

Eight lectures on the following aspects of elementary particle scattering theory are presented: the density matrix, partial wave expansion, polarized target experiments, nucleon-nucleon scattering, hyperon decay, ambiguities in scattering amplitudes, energy dependence of cross sections, and miscellaneous topics of high energy scattering. (M.O.W.)

25890 A UNIFIED DESCRIPTION OF SPACE-TIME AND ISOSPACE. [PART] III. Rayski, J. (Jagellonian Univ., Krakow). Acta Phys. Pol., 29: 519-22(Apr. 1966).

A nonlinear equation, similar to Heisenberg's equation, in a 10-dimensional space with closed subsidiary dimensions is investigated. The intrinsic symmetry group is SU(4), but in a nonrelativistic limit there appears a supersymmetry SU(16) involving the subgroup SU(6). (auth)

25891 NEW SUM RULE ON THE MODULUS OF THE FORWARD SCATTERING AMPLITUDE. Wit, Romuald (Jagellonian Univ., Krakow). Acta Phys. Pol., 29: 563-5 (Apr. 1966).

An integral inequality for ln T(x), where T(x) is the

symmetric forward scattering amplitude, is derived, using the phase representation of T(z). This inequality constitutes a counterpart of the sum rule for Re T(x). (M.J.T.)

25892 STABILITY CRITERIA IN THE SUPERCONDUCTOR MODEL OF ELEMENTARY PARTICLES. Tarjanne, Pekka (Univ. of Oulu, Finland). Ann. Acad. Sci. Fenn., Ser. A VI, 187: 1-27(1965).

The self-consistency equations for the fermion masses in the superconductor model of elementary particles are studied in the one, two and three field cases. Three different stability criteria are applied in order to choose the most stable among the solutions with different symmetry properties. The criteria are shown to favor isotopic spin symmetry and broken unitary symmetry leading to small octet type mass splitting. A crude quantitative calculation leads to a fermion mass splitting of 17%, accidentally in very good agreement with the corresponding experimental baryon splitting. (auth)

25893 A DYNAMICAL DERIVATION OF APPROXIMATE SU(6) SYMMETRY. Lassila, Kenneth E.; Tanaka, Sho (Univ. of Helsinki). Ann. Acad. Sci. Fenn., Ser. A VI, 188: 1-17(1965).

Although it has been noted recently by Lee that from a phenomenological point of view several different models describing baryons as composite states of more fundamental particles are equivalent (that is, they lead to identical SU(3) group symmetry), it seems quite reasonable that the dynamical consequences of these models could be different. A model proposed by Tanaka is considered, which is closely related to some of the models discussed by Lee, where the baryon is taken to consist of a massive singlet boson and three triplet quark-like leptons with spin one half for which none of the quantum numbers have one-third integer values. The fact that the triplet leptons are attracted to the heavy boson leads to an atomic model underlying SU(6) invariance. This, in turn, allows for a natural introduction of a central field approximation with the inclusion of mutual interactions among triplet particles which leads to the result that the 56-dimensional representation of SU(6) forms the ground state for the baryons. The same results can also be deduced for a system of equal mass quarks when strong interactions among them serve to define a self consistent central potential. (auth)

25894 MANY-CHANNEL DYNAMICS, LEVINSON'S THEOREM FOR EIGENAMPLITUDES, AND ONE-CHANNEL CDD POLES. Atkinson, D.; Dietz, K.; Morgan, D. (CERN, Geneva). Ann. Phys. (N. Y.), 37: 77-103(Mar. 1966).

Multichannel dynamical amplitudes can have CDD poles when viewed as the solution of the appropriate one-channel inelastic problem. Manifestations of this phenomenon are investigated. The technique is to work via the eigenamplitudes, in terms of which the essential many-channel dynamics take a simple form; for them, individual Levinson's theorems are derived. On applying the method, it is found that, for a wide class of cases, the phenomenon always occurs in at least one channel and, in many cases, further analysis enables one to say in which one. A speculative application is made to SU_3 bootstraps. (auth)

25895 ASYMPTOTIC BEHAVIOUR OF THE S-MATRIX IN COMPLEX ANGULAR MOMENTUM FOR SINGULAR POTENTIALS. Brander, O. Ark. Fys., 32: 131-65(1966).

Using the theory for the asymptotic solution of differential equations, initiated by Langer and recently developed in great detail by Olver, the asymptotic properties of singular potential scattering theory are studied. More detailed results are obtained than those arrived at earlier (Jakšić and Limić; Tiktopoulos) with the JWKB-method. In particular, explicit formulas for the positions and residues of the Regge poles are obtained. For potentials behaving at the origin like r^{-2-m}, $m > 0$, or like $-r^{-2} \ln r$, explicit calculations are made. It is shown that all potentials having an analytic continuation into the right hand half r-plane satisfying

$$\int^{\infty} |V(r)\, dr| < \infty \quad \text{and} \quad \int_0 |[V(r) - r^{-2-m}] r^{1+(m/2)}\, dr| < \infty$$

in all directions of this half plane, except possibly for parallels to the imaginary axis, have the same asymptotic distribution of Regge poles as r^{-2-m}. For potentials with a logarithmic singularity at the origin the corresponding conditions on the analytic continuation are

$$\int^{\infty} |V(r)\, dr| < \infty \quad \text{and} \quad \int_0 |[V(r) + r^{-2} \ln r] (-\ln r)^{\frac{1}{2}}\, r\, dr| < \infty$$

in all directions of the half-plane, including parallels to the imaginary axis, in order that V(r) shall have the same asymptotic distribution of Regge poles as $-r^{-2} \ln r$. (auth)

25896 ON THE UNITARY IRREDUCIBLE REPRESENTATIONS OF THE PSEUDOORTHOGONAL GROUP L(3,3). Kihlberg, Arne. Ark. Fys., 32: 241-61(1966).

The pseudo-orthogonal group which conserves the quadratic form $x_1^2 + x_2^2 + x_3^2 - x_4^2 - x_5^2 - x_6^2$ together with its Lie algebra is studied. A number of series of unitarity irreducible representations of the universal covering group is derived with a Lie-algebra method, whose justification leans heavily on works by Harish-Chandra. (auth)

25897 SOME NON-COMPACT SYMMETRY GROUPS FOR ELEMENTARY PARTICLES ASSOCIATED WITH A GEOMETRICAL MODEL. Kihlberg, Arne (Chalmers Inst. of Tech., Goteborg). Ark. Fys., 32: 263-74(1966).

Three Lie groups containing the Poincaré group and one of the groups SO(2), L(1,3) or L(3,3) respectively, are studied with respect to their ability of reproducing the spectra of the internal quantum numbers. Their use as interaction symmetry groups is discussed. (auth)

25898 ENERGY AND MOMENTUM AS OBSERVABLES IN QUANTUM FIELD THEORY. Borchers, H.-J. (Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette, France). Commun. Math. Phys., 2: 49-54(1966).

The spectrum condition implies that energy and momentum are limits of local observables. (auth)

25899 SELF-CONSISTENCY AND ELECTROMAGNETIC PROPERTIES OF BARYONS. Lichard, P. (Slovak Technical Univ., Bratislava); Pisut, J. Czech. J. Phys., B16: 267-75(1966).

The self-consistency condition is formulated in wave function formalism of quantum mechanics within the framework of the SU(3) group. Each member of the baryon octet is regarded as a bound state consisting of a baryon and a pseudoscalar meson. From this the electromagnetic properties of baryons are derived. (auth)

25900 MIXING OF ELEMENTARY PARTICLES AND THE MASS FORMULA FOR BOSONS. Formanek, J. (Czech Technical Univ., Prague). Czech. J. Phys., B16: 276-80(1966).

The possibility of the existence of $\eta - \eta_{2\pi}$ mixing and the question of the Gell-Mann-Okubo formula for bosons are considered. (auth)

25901 LIE GROUP OF INFINITE ORDER AS A NON-TRIVIAL COUPLING OF INTRINSIC AND SPACE-TIME SYMMETRIES. II. Fromanek, J. (Czech Technical Univ., Prague). Czech. J. Phys., B16: 281-9(1966).

A real Lie algebra of denumerable infinite order that contains as subalgebras the Poincare algebra P and the algebra SU(3) is derived by the method introduced. A non-trivial mass formula is obtained. (auth)

25902 GAUGE FIELDS OF AN ALGEBRAIC HILBERT SPACE. Horwitz, L. P. (Univ., Geneva). Helv. Phys. Acta, 39: 144-54(1966).

The theory of a spinor particle in the presence of a Yang-Mills type field provides an example of an algebraic Hilbert space, i.e., a vector space linear over quantities of a non-commutative algebra. A discussion of the field equations applicable when the gauge field belongs to a general finite algebra is given. It is shown, considering only the unquantized spinor field, that the hamiltonian operator is not an observable. The system described by these field equations does not have, for example, a well-defined rest mass, and it consequently does not seem to correspond to the type of object one conventionally accepts as an elementary particle. (auth)

25903 MASS FORMULAS IN WEAKLY BROKEN SU(3) SYMMETRY. Levin, E. M.; Frankfurt, L. L. (Ioffe

Physico-Technical Inst., Leningrad). JETP Lett. (USSR) (Engl. Transl.), 3: 79-81(Feb. 1, 1966).
Translated from Zh. Eksp. Teor. Fiz., Pis'ma Redakt., 3: 125-9(Feb. 1, 1966).

A derivation of the relation between the masses of particles of arbitrary spin that belong to different SU(3) multiplets is outlined. (D.C.W.)

25904 OCTET THEORY OF THE SU_3 GROUP AND THE CLASSIFICATION OF STRONGLY INTERREACTED PARTICLES. Kao, Ch'ung-shou. K'o Hsueh T'ung Pao, No. 12, 1081-92(1964).

In recent years, many strongly interacted resonance states have been discovered in experiments in high energy physics. Among the existing symmetrical theories, the octet theory of the SU_3 group yields better results when applied to established resonance states and fundamental particle groupings. In this theory, the fundamental particle and resonance state can be classified according to the equation: $8 \times 8 = 1 + 8 + 8 + 10 + 10^* + 27$. An attempt is made to summarize recent work, which deals mainly with the following: The classification of κ particles. Recent experiments have shown that near mass m = 725 Mev, there exists a $K\pi$ resonance state κ with spin T = $\frac{1}{2}$. If one only considers the case when the spin $J \leq 1$, then the spin value of κ is either 0^+ or 1^-. The classification of new resonance states. Recently, another series of new meson resonance states were discovered, such as $\pi\omega$ resonance B(1,220), $K\frac{1}{0}K^{*}\pi^{*}$ resonance (1,410), $\rho^{0}\pi^{+}$ resonance $A^+(1.0-1.4$ Bev), $K\pi\pi$ resonance (1,175) and $K\rho$ resonance C(1,230), etc. Whether these resonance states can be classified in the SU_3 group is not quite clear at this time. Near 1,600 Mev, there is no $\Xi\pi$ resonance with T = $\frac{1}{2}$. Experiments have demonstrated that $N^*(1,515)$ and Y_0^{**} (1,520) are meson resonance states with $J^P = \frac{3}{2}^-$. Recent experiments also demonstrated that the spin of $Y_1^{**}(1,660)$ is $\frac{3}{2}$. Glasgow and Rosenfeld postulated this spin value to be negative, and classified this and $N^{**}(1,515)$, $Y_0^{**}(1,520)$ as one group; they then predicted that near M = 1,600 Mev there should exist a $\Xi\pi$ resonance state Ξ^{**} with T = $\frac{1}{2}$, $J^P = \frac{3}{2}^-$. Recent experiments revealed, however, that there is no resonance near 1,600 Mev, but at 1.7-1.8 Bev a high peak was observed, which showed that there may be a $\Xi\pi$ resonance with T = $\frac{1}{2}$. (ATD)

25905 MASSLESS PARTICLES AND THE GOLDSTONE THEOREM. Guralnik, G. S.; Hagen, C. R. (Imperial Coll. of Science and Tech., London). Nuovo Cimento (10), 43A: 1-32(May 1, 1966).

The general circumstances under which a symmetry breaking can occur in a relativistic field theory are considered in some detail. It is found that only such theories which are invariant with respect to a class of constant gauge transformations on the canonical field variables will necessarily support a broken-symmetry condition. While theories of this type generally possess an associated Goldstone theorem based on the elements of the canonical group, the consequent massless particle is seen to emerge more immediately as a direct result of the canonical commutation relations and the local conservation law implied by this extended gauge invariance. It is further shown that in a theory which accidentally possesses zero-mass quanta as well as a conserved bilinear current operator, there are an infinite set of broken-symmetry solutions as a consequence of an asymptotic invariance under the constant gauge group. This result is equivalent to the converse of the usual G ' ' ' ne theorem and serves to emphasize in a dramatic way the unique correspondence between massless particles and broken symmetries. The equivalence thus demonstrated must cast considerable doubt on the consistency of any broken-symmetry theory in which a massless particle arises solely through the Goldstone theorem with no reference to the detailed dynamics of the system. (auth)

25906 ALEGBRA OF CURRENTS IN NONZERO MOMENTUM STATES. Khanna, M. P. (Univ. of Rochester, N. Y.); Okubo, S.; Mukunda, N. Nuovo Cimento (10), 43A: 33-42(May 1, 1966). (UR-875-115).

It is shown that the SU_4 or SU_6 algebra of currents has no consistent solution for nonzero-momentum states in the approximation of dominance of low-lying intermediate states, in contrast to the case of zero-momentum states investigated by several authors. (auth)

25907 RELATION BETWEEN ELASTIC DIFFRACTION SCATTERING AND DYNAMICS OF MULTIPLE MESON PRODUCTION IN THE VERY-HIGH-ENERGY REGION. Fukuda, H.; Iso, C. (Tokyo Inst. of Tech.). Nuovo Cimento (10), 43A: 43-70(May 1, 1966).

The phase of the single-particle wave function (defined by Van Hove) is calculated in the known model, fireball model and hydrodynamical model, and the slope of the angular distribution of the diffraction scattering is calculated qualitatively. If the main inelastic event is something like the hydrodynamical model, $\alpha \sim 10$ Bev^{-2}($d\sigma/dt \propto \exp[\alpha t]$) is obtained. On the contrary, under the assumption of the fireball model we cannot get such a large value of α except if the lifetime of the fireball is unreasonably large ($\tau \sim 2.5/\mu$). It is concluded that the fireball model is not the main inelastic process, but the only model with strong final-state interaction that could explain the diffraction scattering at small angle. (auth)

25908 THE DASHEN-FRAUTSCHI PERTURBATION METHOD FOR A POTENTIAL MODEL. Paton, J. E. (Clarendon Lab., Oxford). Nuovo Cimento (10), 43A: 101-18(May 1, 1966).

The method of Dashen and Frautschi for calculating the effects of perturbations on the strong interactions is investigated in a potential theory model. The effect of a perturbation is considered on the binding energy of the lowest s-wave bound state in an exponential well. When evaluated exactly the dispersion integral for the change in binding energy reproduces the standard result of first-order perturbation theory. The effect is considered of approximating the dispersion integral in the way that would be necessary in a relativistic calculation. Both long- and short-range perturbations are considered. Provided the binding energy is small enough, the dispersion integral converges quickly enough for the simplest approximation to it (first Born approximation for the left-hand cut of the change in the partial-wave amplitude) to give a value for the change in binding energy of the right sign and order of magnitude; first and second Born approximations give about 90% of the total shift in binding energy. However, as the coupling in the coupling in the unperturbed problem becomes stronger, the dispersion integral converges more slowly. If the coupling is strong enough almost to bind a second s-wave state, first Born approximation becomes entirely inadequate. For one of the short-range perturbations considered, even first and second Born approximations give a shift in binding energy of the wrong sign in this case. Some comments are made concerning various methods of treating long-range perturbations. (auth)

25909 POSITIVE-PARITY MESONIC STATES AND UNITARY SYMMETRY. Dutta-Roy, B.; Pundari, S. Baba (Saha Inst. of Nuclear Physics, Calcutta). Nuovo Cimento (10), 43A: 119-22(May 1, 1966).

The only physically realized meson SU_6 supermultiplet (the 35-plet of pseudoscalars and vectors) is not amenable to an application of pure SU_6 in as far as decays are concerned. Evidence is presented for a possible octet of 0^+ (scalar) and a nonet of 1^+ (axial-vector) mesons, which together form a 35-plet SU_6 supermultiplet. Pure SU_6 is applied to the decays and satisfactory agreement with experiment is obtained. (auth)

25910 THE PARITY TRANSFORMATION FOR A SYMMETRY MODEL WHICH USES UNITARY REPRESENTATIONS OF THE GROUP $SL_{n,C}$. Ruehl, W. (CERN, Geneva). Nuovo Cimento (10), 43A: 171-9(May 1, 1966).

The parity operation is studied for a model that involves infinite multiplets and is based on groups $SL_{n,C}$. The postulate that the parity reflection should not double the representation space leads to restrictions on the invariants of the group. The investigation makes use of the theory of Gel'fand and Neumark. The connection with the tensor calculus is discussed. (auth)

25911 LOCAL COMMUTATION RELATIONS OF VECTOR AND AXIAL CURRENTS AND THEIR APPROXIMATE SATURATION. Celeghini, E. (Istituto Nazionale di Fisica Nucleare, Florence); Gatto, R. Nuovo Cimento (10), 43A: 219-24(May 1, 1966).

The approximate saturation of the local commutation relations of the vector and axial currents, are considered, both among their fourth components and among their space components, with state N and N* (and corresponding states when there is change of strangeness). Sum rules are obtained (at any q^2) involving bilinear combinations of nucleon form factors and of form factors for N-N* transitions. In particular the sum rules and their derivatives, at $q^2 = 0$, are discussed. (L.B.S.)

25912 LONG-WAVELENGTH MODES AND STABILITY OF A SPIN-DENSITY-WAVE STRUCTURE IN A FERMI GAS. Celli, V. (Univ., Bologna); Morandi, G.; Fano, G. Nuovo Cimento (10), 43B: 42-63(May 11, 1966).

The collective modes of a spiral spin-density-wave (SDW) structure are investigated in a one-dimensional model of a Fermi gas. The equations of motion in the random-phase approximation are written down in general and solved in the long-wavelength limit at zero temperature, for a delta-function interaction between the fermions. Two collective modes are found, both with a linear dispersion relation at long wavelengths. One of them becomes purely longitudinal, i.e., a density fluctuation, in the normal (paramagnetic) state. The other becomes purely transverse in the normal and in the ferromagnetic state. The frequency of this mode becomes imaginary when the SDW structure is unstable with respect to the ferromagnetic state. Another instability is found, and its possible origin is briefly discussed. (auth)

25913 SUBTRACTIONS IN PARTIAL-WAVE DISPERSION RELATIONS. Kinoshita, Toichiro (Cornell Univ., Ithaca, N. Y.). Phys. Rev. Lett., 16: 869-71(May 9, 1966).

The nature of the supplementary assumptions one has to make in order to obtain the desired result in the application of partial-wave dispersion relations in strong interaction physics is examined. The weakest assumption that has been found thus far is presented. (B.G.D.)

25914 PARTICLES OF MODERN PHYSICS. Frisch, O. R. (Cambridge Univ., Eng.). Proc. Inst. Elec. Eng. (London), 113: 529-37(Mar. 1966).

The purposes, techniques, and achievements of high-energy physics research are discussed. The operation and capabilities of synchrotrons and track-forming detectors are sketched. The history of the discovery of various particles—electron, photon, proton, neutron, positron, antiparticles, neutrino, muon and pion, baryon resonances, and mesons—is recounted, and some properties of these particles and various models developed to explain them are described. (M.J.T.)

25915 CURRENT-GENERATED ALGEBRA AND MASS-SPLITTING. Kikkawa, Keiji (Univ. of Tokyo). Progr. Theoret. Phys. (Kyoto), 35: 304-8(Feb. 1966).

The current-generated algebra is applied to the mass-splitting problem of the hadrons. The splitting of any SU(3) multiplet can be described by using only one parameter common to all multiplets. (auth)

25916 SYSTEMATICS AND PHENOMENOLOGY OF BOSON MASS LEVELS. II. Iizuka, Jugoro (Kanazawa Univ., Japan). Progr. Theoret. Phys. (Kyoto), 35: 309-14(Feb. 1966).

Considerations given previously are extended and applied to the masses of the predicted 0^+-nonet and others. Some remarks are made concerning two currently fashionable trends, namely the adoption of squared-mass relations for bosons and the tendency to regard the lowest mass levels of the hadrons as completely typical of their general characteristics. (auth)

25917 SPLIT EXTENSION OF INTERNAL SYMMETRY GROUP BY THE POINCARE GROUP. Mugibayashi, Nobumichi (Kobe Univ., Japan). Progr. Theoret. Phys. (Kyoto), 35: 315-29(Feb. 1966).

The problem of combining internal symmetry and Lorentz invariance is thoroughly investigated for the case when the Poincaré group is an invariant subgroup of a larger symmetry group. It is found that couplings are all "minimal" if the internal symmetry group does not have an abelian factor group. Possible couplings of this type are enumerated for the semi-simple internal symmetry group. A condition for releasing the coupling is also given, which is weakest among similar ones proposed so far in this direction. Physical implications of the result are not discussed. (auth)

25918 ELECTROMAGNETIC MASS DIFFERENCES IN THE QUARK MODEL. Arafune, Jiro; Iwasaki, Yoichi (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto), 35: 339-41(Feb. 1966).

A quark magnetic moment of the same order of magnitude as that of the proton for which the magnetic moment interaction is of the same order of magnitude as that of the Coulomb interaction is postulated for hadron mass differences. The results for baryons and for 0^- and 1^- mesons are given. (J.F.P.)

25919 INTEGRAL EQUATIONS IN THE ONE-CHANNEL RELATIVISTIC CASE, INCLUDING CDD POLES. Stihi, M.; Visinescu, M. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys., 11: 17-29(1966).

Proceeding from the discontinuity along the unphysical cut and from the analytic properties of the S matrix, integral equations for a function D(k), similar to the Jost function are established. These equations exhibit explicitly the CDD poles. (auth)

25920 NOTE ON THE S-MATRIX SINGULARITIES IN THE EFFECTIVE RANGE APPROXIMATION. Radescu, E.; Visinescu, M. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys., 11: 31-7(1966).

An application of a previous work concerning the sign of the effective-range parameter to the study of the position of S matrix poles for the cases of single channel and two coupled channels (S-wave) is given. An expression for the scattering length and for the effective range parameter in terms of the poles corresponding to bound, antibound and resonant states in the one-channel case, l-wave ($l > 0$) is obtained. (auth)

25921 DETERMINATION OF THE QUADRISPINORS ATTACHED TO THE MAXIMUM SPIN FIELDS 1 AND 1/2. Popovici, I.; Popovici, A. Stud. Cercet. Mat., 16: 837-47 (1964). (In French).

The hexadimensional theory and the quadridimensional one were studied in a continuation of previous work. (Rum. Sci. Abstr.)

25922 COVARIANT THEORY OF SPINORIAL ALGEBRAIC RELATIONS OF MAXIMUM SPIN FIELDS 1 AND 1/2. Hristev, A. P. Stud. Cercet. Mat., 16: 850-60 (1964).

Investigations were carried out on the polydimensional conformal theory of elementary particles. The theory of unification of Dirac matrices and mesonic fields is discussed. An algorithm theorem is also given, by means of which spinorial algebraic identities and general tensorial identities are automatically developed. Various identities for two and three spinorial fields are given. The bilinear identities for two spinorial fields are classified into four groups: (bilinear) relations of interaction between two spinorial fields; (quadratic) relations of self-activity of a spinorial field; relations of fusion of two spinorial fields and between the mesonic field and the two-component spinorial fields; and relations of self-fusion of a spinorial field. By applying the algorithm theorem to three spinorial fields trilinear identities were obtained, whose term structures are similar to those of the interaction Lagrangians (contracted products of the interaction field tensors). They are therefore general relations of interaction between mesonic and spinorial fields. These relations express the symmetry and antisymmetry properties of the interactions function of the permutations of the spinorial fields or of the adjoining ones. They may be classified as follows: relations of interaction between the mesonic and spinorial

fields and combined relations of interaction between the mesonic fields and current-charge densities and the spinorial fields. The structure of the established interaction relations emphasizes certain properties of symmetry and reciprocity between the mesonic fields and the two associated charge-current densities: invariance with the permutation of the spinorial fields between them and of the conjugated mesonic fields between them; equivalence between the mesonic-spinorial interactions as well as between those occurring between charge-current fields and spinorial ones; and reciprocity between the mesonic fields and the charge-current densities. Tensorial indentities mesonic bilinear or spinorial quadrilinear were examined. The general relations of interaction between the mesonic fields are classified into four groups: relations of interaction between two mesonic fields having either the first or the second spinor in common; relations of the self-activity of the charge-current densities; relations of interaction between the mesonic fields and the associated charge-current densities; and relations of fusion and fission between the mesonic fields and the charge-current densities. (Rum. Sci. Abstr.)

25923 THE GROUP SU_4 AND SYMMETRY OF THE ELEMENTARY PARTICLES. Yeh, Peng-sheng (Futan Univ., Shanghai). Wu Li Hsueh Pao, 22: 163-73(Feb. 1966). (In Chinese).

The general theory of Lie groups is used to discuss concretely the mathematical treatments of the group SU_4. The algebraic structure of the group SU_4, the formula for the dimensions of the irreducible representation, the explicit form of the three elementary representations, and the reduction of direct products of representations are given. The following symmetry models of the elementary particles based on the group SU_4, are built: (1) the model of Bacry-Van Hove, (2) the model of Schwinger, (3) the model of Sakata with particle and antiparticle symmetry, and (4) the octet model with particle and antiparticle symmetry. In these models some new consequences consistent with experiments are obtained. (auth)

25924 INTERACTIONS OF BARYONS WITH MESONS AND ELECTROMAGNETIC FIELD IN THE SU(6) SYMMETRY. Volkov, D. V. Yadern. Fiz., 3: 526-32(Mar. 1966). (In Russian).

Relations between the coupling constants of baryons with mesons or with the electromagnetic field are considered, assuming that the SU(6) invariance of the vertex functions, describing the interaction, is broken only by the existence of two independent particle momenta in these functions. Consequences of the additional assumption, that the relative contribution of various possible variants is completely determined by kinematical factors, depending on the structure of the variant and on the mass ratio of the interacting particles, are investigated. (auth)

25925 STATIC CHARACTERISTICS OF HADRONIC INTERACTIONS IN BROKEN SU(6) SYMMETRY. Gedalin, E. V.; Kancheli, O. V.; Matinyan, S. G.; Chkareuli, Dzh. L. (Inst. of Physics, Academy of Sciences, Georgian SSR). Yadern. Fiz., 3: 533-40(Mar. 1966). (In Russian).

The static characteristics of weak, electromagnetic, and strong baryon and meson interactions are considered in the broken SU(6)-symmetry. (auth)

25926 BARYON AND MESON DECAY PRODUCING ELECTRON-POSITRON PAIRS IN THE $\tilde{U}(12)$ SYMMETRY. Duc, Dao Wong (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 3: 545-8(Mar. 1966). (In Russian).

The decay of baryons and mesons with the creation of an electron-positron pair is considered in the framework of the $\tilde{U}(12)$-symmetry. Experimentally verifiable expressions are obtained for the energy spectra of the final baryon and meson. (auth)

25927 STRUCTURE OF VERTICLES IN SL(6) AND $\tilde{U}(12)$ SYMMETRIES. Nguyen Van Hieu; Tu, Pham Qui (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 3: 551-60(Mar. 1966). (In Russian).

The connection between the SL(6) and $\tilde{U}(12)$ groups and their representations is considered. It is shown that several irreducible representations of SL(6) are contained in each representation of the group $\tilde{U}(12)$. The connection between vertices in these symmetries is investigated. Relations between the matrix elements for weak and electromagnetic decays of mesons following from SL(6) and $\tilde{U}(12)$ are obtained. (auth)

25928 RESTRICTIONS ON IMAGINARY PART OF THE SCATTERING AMPLITUDE AT HIGH ENERGIES. Popov, V. S.; Mur, V. D. (Inst. of Theoretical and Experimental Physics, State Atomic Energy Commission, USSR). Yadern. Fiz., 3: 561-8(Mar. 1966). (In Russian).

A restriction on the behavior of the imaginary part A(s,t) of the elastic scattering amplitude is obtained for high energies, following from the general principles of quantum field theory: analyticity with respect to the momentum transfer and unitarity in the s channel (the region $0 < t < 4\mu^2$ of momentum transfers is considered). Inequalities are found for the derivatives $d^nA(s,t)/dt^n$ at $t = 0$, following from unitarity in the s-channel. (auth)

25929 THREE-PARTICLE SCATTERING PROBLEM IN QUANTUM MECHANICS. Vedrinskii, R. V. (Rostov-on-Don State Univ., USSR). Yadern. Fiz., 3: 569-74(Mar. 1966). (In Russian).

The uniqueness of the solution of the Lippman–Schwinger equation in the three-body problem is considered. The analysis performed makes it possible to write down equations for the scattering amplitude, which prove to be equivalent to the Faddeev equations. It is shown that other interconnected systems of equations exist. The Faddeev and Gribov equations are shown to be equivalent. The problem of δ-type singularities in the scattering amplitude is investigated. (auth)

25930 MASS FORMULA IN THE SU(6)-SYMMETRY THEORY. Achasov, N. N.; Kadyshevskii, V. G.; Muradyan, R. M. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 3: 719-21(Apr. 1966). (In Russian).

Mass formulas are obtained for arbitrary SU(6)-multiplets. The splitting of the 35- and 56-plets is considered in detail. (auth)

25931 CLOSE CONNECTION BETWEEN THE NONRELATIVISTIC PARTIAL AMPLITUDE AND THE TRAJECTORIES OF ITS POLES IN THE λ PLANE. Lomsadze, Yu. M.; Tokar', S. S. (Uzhgorod State Univ., USSR). Yadern. Fiz., 3: 726-8(Apr. 1966). (In Russian).

A relation is obtained between the nonrelativistic partial amplitude $f_\lambda(l,s)$ of scattering by potential $\lambda V(r)$ and the trajectories and residues of its poles. An asymptotic behavior is established if $|\lambda| \to \infty$ in an arbitrary direction in λ-plane If $s \to \infty$, $f_\lambda(l,s)$ is completely determined by the Born approximation. (auth)

25932 CONSEQUENCES OF THE BETHE-SALPETER EQUATION. Dremin, I. M. (Lebedev Inst. of Physics, Moscow). Yadern. Fiz., 3: 752-5(Apr. 1966). (In Russian).

Consequences are considered of the Bethe-Salpeter equation written in different (s and t) channels. It is shown that under certain conditions, there is no narrowing of the diffraction peak in the scattering of π-mesons on arbitrary particles. Relations between the cross sections of peripheral and central collisions, following from symmetry theories, are obtained. A model is suggested in which the elements of the K-matrix find a simple graph interpretation. (auth)

25933 ON THE THEORY OF THE DISPERSION RELATIONS. [PART] I. Perlman, M. E. (Inst. of Cybernetics, Academy of Sciences, Georgian SSR). Zh. Eksp. Teor. Fiz., 50: 613-25(Mar. 1966). (In Russian).

The main postulates of field theory, viz. relativistic causality and mass-spectrality, are written down for the functions of a single four-dimensional variable as restriction functional equations. The Fourier convolution of the equations directly yields the relativistic spectral representations and dispersion relations, which generalize and make more concrete the Kramers–Kronig, Källen–Lehman and Dyson representations and also their inversions. Similar relations are derived in the x representa-

tion. All relations can be written down as equations of motion in x and p spaces with unspecified interaction. This proves complementarity of the equation of motion method and dispersion relations theory. (auth)

25934 INVESTIGATION OF INFRARED SINGULARITIES OF THE SCATTERING CROSS SECTION BY THE FUNCTIONAL INTEGRATION METHOD. Barbashov, B. M.; Volkov, M. K. (Joint Inst. for Nuclear Research, Dubna, USSR). Zh. Eksp. Teor. Fiz., 50: 660-71(Mar. 1966). (In Russian).

Mutual scattering of high energy scalar particles of mass m is studied by the functional integration method. The process is treated on basis of the scalar particle model with a Lagrangian $L = g:\psi^2(x)\varphi(x):$ where the field $\psi(x)$ has a mass m and $\varphi(x)$ a zero mass. The contribution of virtual quanta of field $\varphi(x)$ with $k^2 = 0$, which leads to infrared divergence of the elastic process amplitude, is taken into account exactly. A procedure for compensating infrared divergences is carried out outside the framework of perturbation theory by taking into account in the cross section such processes that involve the emission of an infinite number of real quanta from field $\varphi(x)$, their total energy not exceeding a certain quantity Δ. (auth)

25935 RELATION BETWEEN ASYMPTOTIC VALUES OF THE TOTAL CROSS SECTION AND THE RATIOS OF THE IMAGINARY TO REAL PARTS OF THE AMPLITUDE FOR ELASTIC SCATTERING THROUGH AN ANGLE 0 DEG. Vernov, Yu. S. (Lebedev Inst. of Physics, Moscow). Zh. Eksp. Teor. Fiz., 50: 672-9(Mar. 1966). (In Russian).

A number of restrictions from above as well as below on the asymptotic values of the total cross section are obtained as a function of the asymptotic value of the ratio of the imaginary and real parts of the elastic scattering amplitude. It is shown that if the amplitude is asymptotically not purely imaginary, the cross section will increase according to a power law if the real part is positive and decreases according to a power law if the real part is negative. If the elastic scattering amplitude is asymptotically purely imaginary, the cross section may increase or decrease at a rate which is slower than that at which the energy in any degree may vary. (auth)

25936 ON THE POSSIBILITY OF A DYNAMIC PRESCRIPTION OF THEORY IN THE WIGHTMAN AXIOMATIC SCHEME. Vasil'ev, A. N. (Leningrad State Univ.). Zh. Eksp. Teor. Fiz., 50: 694-708(Mar. 1966). (In Russian).

The concept of a set of dynamic equations of theory is introduced within the framework of the Wightman axiomatics. A dynamic equation is an arbitrary relation of the type $a(g) = 0$ with $a(g)$ from (I) where $\varphi(x)$ is the field operator of the theory and g is an element of the space for which the Wightman functional W is defined (usually as test functions $g_i(x_1 \ldots x_i)$ infinitely differentiable rapidly decreasing functions from S space are taken). The problem of the relation between theories with the same set of dynamic equations is discussed. From this viewpoint the choice of space for which the functional W is defined is of importance; the wider this space the more number of dynamic equations can be written down and hence the more information they contain. For a sufficiently broad class of theories (including in particular all local theories) it is demonstrated that the functional W can be satisfactorily defined for a more extensive class of test functions than S. The main result of the work is a proof of the following statement: the irreducible Wightman functional W considered as a functional for the extended space may be prescribed dynamically (i.e., the respective set of dynamic equations defines it uniquely). However, if the functional W is reducible but can be expanded into a finite number of irreducible functionals then its set of dynamic equations uniquely defines all irreducible components of the functional. (auth)

25937 BORN APPROXIMATION AND DISPERSION RELATIONS FOR SINGULAR POTENTIALS. Martin, A. (CERN, Geneva). pp 17-22 of Preludes in Theoretical Physics. Amsterdam, North-Holland Publishing Co., 1966.

Recent developments in the field of scattering theory are presented. An inquiry is made to see if the forward scattering amplitude of singular repulsive potentials satisfy dispersion relations. It is shown that for positive and negative energies, both the partial wave and the forward scattering amplitudes exist in the singular and can be bounded by a known integral. It is also shown how one can "continue" dispersion relations from the nonsingular case to the singular case. (B.G.D.)

25938 POLARIZATION AND ZEROS OF THE SCATTERING AMPLITUDE. De-Shalit, A. (Weizmann Inst. of Science, Rehovoth, Israel). pp 35-43 of Preludes in Theoretical Physics. Amsterdam, North-Holland Publishing Co., 1966.

An investigation of diffraction-like phenomena in terms of zeros of the scattering amplitude is presented to clarify some regularities observed in the polarization accompanying some scattering and reaction processes. (B.G.D.)

25939 CHARGE CONJUGATION OPERATION AND MIXED SPACE-TIME-INTERNAL SYMMETRY GROUPS. Okubo, S.; Marshak, R. E. (Univ. of Rochester, N. Y.). pp 51-8 of Preludes in Theoretical Physics. Amsterdam, North-Holland Publishing Co., 1966.

An examination of the charge conjugation properties of the recently developed higher symmetry groups which mix the space-time and internal symmetry is presented. The argument which demonstrates the inconsistency between the usual definition of the charge conjugation operation for the basic Dirac spinor fields which are used to define the multispinor representations of the U(12) group and the U (12) invariant definition of the baryon-meson vertex is discussed, along with how the difficulty can be remedied for a mixed space-time interval symmetry group like U(12). (B.G.D.)

25940 SYMMETRIES OF FORCES AND STATES. Oppenheimer, Robert. pp 70-7 of Preludes in Theoretical Physics. Amsterdam, North-Holland Publishing Co., 1966.

A general discussion is presented of two syntheses in the understanding of physics which have outgrowths in the ideas of relativity and quantum theory. The first is Yukawa's invention that the mesons are carriers of forces between nucleons which is based on an analogy with electrodynamics. The other synthesis is symmetry, which is based on the detailed analysis of low energy proton–proton scattering by Breit and was the recognition of the charge independence of nuclear forces. (B.G.D.)

25941 GROUP S_3 AND STRONG INTERACTIONS. Yamaguchi, Yoshio (Tokyo Univ.). pp 78-88 of Preludes in Theoretical Physics. Amsterdam, North-Holland Publishing Co., 1966.

A discussion of the symmetry property of elementary particles in terms of finite groups is presented. Topics included are the use of finite groups, S_3 and level scheme, and construction of a model of strong interactions based on S_3 symmetry. (B.G.D.)

25942 DIFFRACTION MODELS FOR DIRECT NUCLEAR AND HIGH-ENERGY PROCESSES. Henley, Ernest M. (Univ. of Washington, Seattle). pp 89-99 of Preludes in Theoretical Physics. Amsterdam, North-Holland Publishing Co., 1966.

Diffraction models are presented to examine relations between various direct nuclear and high energy processes which are able to give insight into reaction mechanisms and yield quantitative information for the partial and total cross sections without having many (if any) adjustable parameters. (B.G.D.)

25943 INTUITIVE ANALYTICITY. Kaellen, Gunnar (Univ. of Lund, Sweden). pp 100-9 of Preludes in Theoretical Physics. Amsterdam, North-Holland Publishing Co., 1966.

The physical significance of the analyticity concept in field theory and elementary particle physics is discussed. This discussion is limited to one example, the vacuum polarization in quantum electrodynamics, and one mathematical expression, the vacuum expectation value of a product of two operators. (B.G.D.)

25944 A NOTE ON BARYON MASSES, MASS DIFFERENCES, AND MAGNETIC MOMENTS, ACCORDING TO VARIOUS SYMMETRY SCHEMES. Feld, Bernard T. (Massachusetts Inst. of Tech., Cambridge). pp 110-19 of Preludes in Theoretical Physics. Amsterdam, North-Holland Publishing Co., 1966.

The relation among the static properties of the baryons in terms of simple physical ideas following from the assumed symmetry properties of the fundamental interactions among elementary particles is discussed. The discussion is confined to three such symmetry schemes, namely, the doublet model in which the basic symmetry gives rise to four isotopic doublets of baryons, the Fermi-Yang-Sakata model in which all the observed particles (mesons and baryons) are regarded as compound states of a basic baryon-triplet (p,n,Λ^0), and the octet model of Gell-Mann and Ne'eman, in which the basic symmetry among the baryons derives from eight-fold representation of the group SU(3), thereby including the eight observed baryons. (B.G.D.)

25945 THEORETICAL CONSIDERATIONS ON THE REAL PART OF THE FORWARD SCATTERING AMPLITUDE. Kinoshita, Toichiro (Cornell Univ., Ithaca, N. Y.); Khuri, N. N. pp 120-32 of Preludes in Theoretical Physics. Amsterdam, North-Holland Publishing Co., 1966.

Results are presented of recent investigations on whether or not the present dispersion relations can be used in such a manner that the influence of the asymptotic behavior of the scattering amplitude is eliminated or reduced as much as possible. New type of sum rules satisfied by the real part of the forward scattering amplitude are discussed. The method developed for this purpose was found to be useful for the study of the relation between the asymptotic behavior of the forward scattering amplitude and that of the ratio of the real and imaginary parts of the scattering amplitude. (B.G.D.)

25946 LORENTZ COVARIANT SUPERMULTIPLET SCHEME FOR STRONG INTERACTIONS. Oehme, Reinhard (Univ. of Chicago). pp 143-53 of Preludes in Theoretical Physics. Amsterdam, North-Holland Publishing Co., 1966.

The description of a Lorentz-covariant scheme for elementary particle interactions, which reproduces the successful features of non-relativistic SU(6) models is presented. Although it is apparently not possible to have a reasonable theory with finite multiplets which is Lorentz invariant, and which also complies with all the basic assumptions of field theory or of dispersion theory, an attempt is made to determine an approximate scheme for S-matrix elements and form factors. (B.G.D.)

25947 THE SU_3 MASS FORMULA. Huang, Kerson (Massachusetts Inst. of Tech., Cambridge). pp 177-82 of Preludes in Theoretical Physics. Amsterdam, North-Holland Publishing Co., 1966.

The usual derivation of the mass formula of Gell-Mann and Okubo for particles belonging to SU_3 super multiplets is pointed out as being incomplete, and that its validity seems to indicate the existence of a mechanism that regulates the masses of fundamental particles. The suggestion that this mechanism is the so called "bootstrap" is discussed. (B.G.D.)

25948 LOCALIZATION IN CLASSICAL FIELDS OF ENERGY, MOMENTUM, AND CHARGE. Wentzel, Gregor (Univ. of Chicago). pp 199-204 of Preludes in Theoretical Physics. Amsterdam, North-Holland Publishing Co., 1966. (COO-264-253; EFINS-65-33).

The classical field, with components $\psi_\sigma(x_\nu)$ $[\sigma = 1,2, \ldots n; \nu = 1, \ldots 4]$ and which has field equations given in terms of a lagrangian density L which is a function of ψ's and their first derivatives is discussed. Lorentz-invariant lagrangians lead to relativistically covariant field equations, and a symmetric energy-momentum tensor can then be constructed from L. Another invariance property of L, gauge-invariance of the first kind, which allows definition of conserved currents, is also discussed. The change in the lagrangian density by adding a divergence in which the field equations are unaltered is considered. (B.G.D.)

25949 VERTICES WITH PARTIAL SU(6,6) STRUCTURE. Pais, A. (Rockefeller Inst., New York). pp 302-12 of Preludes in Theoretical Physics. Amsterdam, North-Holland Publishing Co., 1966.

An analysis is presented of the effective vertex (three-point) structure where the principal successes of SU(6) were found and an examination of conditions which led to the partial SU(6,6) structure. A brief discussion is given of some properties of boost matrices and the Lorentz transformations of supermultiplets. A short derivation of the vertex structure is included. (B.G.D.)

25950 XII INTERNATIONAL CONFERENCE ON HIGH ENERGY PHYSICS, DUBNA, AUGUST 5–15, 1964. VOL. 1. Smorodinskii, Ya. A.; Grishin, V. G.; Komar, A. A.; Nikitin, V. A.; Solovev, L. D.; Korenchenko, S. M. (eds.). Moscow, Atomizdat, 1966. 1024p. (In English and Russian). (CONF-550-(Vol.1)).

Approximately 250 articles are included on experimental and theoretical studies of pion-nucleon interactions, general principles of local field theory, the method of complex angular momenta in field theory, experimental studies of resonances with zero strangeness and of strange-particle resonances, theoretical studies of strong interaction symmetries, and experimental and theoretical studies of electromagnetic interactions. (M.J.T.)

Fluid Physics and Thermodynamics

See also Plasma Physics and Thermonuclear Processes

Refer also to abstracts 25260, 25262, and 26345.

25951 (N-65-35269) MAGNETOHYDRODYNAMIC SHOCK STRUCTURE IN A MOVING MAGNETIC FIELD. Beard, David B. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). June 1964. 24p. (NASA-TM-X-51860; X-640-64-161). CFSTI $1.00 cy, $0.50 mn.

The shock structure around a cylinder immersed in a cold collisionless plasma stream containing a weak magnetic field was investigated in two dimensions. The stream pressure on the boundary of the sheath is proportional to $\cos^2\Psi$ where Ψ is the angle between the stream velocity and the normal to the sheath. The thickness of the sheath and particle density in the sheath on the upstream side of the cylinder were found to be nearly constant. A tear-drop-shaped vacuum is formed downstream from the cylinder. The plasma electrons have essentially all the ion stream kinetic energy in the transition sheath upstream of the cylinder, but the ion stream energy is regained downstream from the cylinder. The importance of this shock structure when applied to the earth's magnetosphere and the generation of Type-1 comet tails is discussed briefly. (STAR)

25952 TRANSPORT EQUATION FOR QUASIPARTICLES IN A SYSTEM OF INTERACTING FERMIONS COLLIDING ON DILUTE IMPURITIES. Betbeder-Matibet, O.; Nozieres, P. (Ecole Normale Superieure, Paris). Ann. Phys. (N. Y.), 37: 17-54(Mar. 1966).

Landau's transport equation is derived for quasiparticles in a Fermi liquid in the presence of static impurities. This equation provides the linear response of the system to a macroscopic excitation at zero temperature, the collision time τ being such that $h/\tau \ll E_f$. Calculations are performed in the framework of Green's function perturbation theory. The influence of collisions on the singularities of propagators is investigated. A calculation of the distribution function in a simple case sheds some light on the validity of the transport equation. (auth)

25953 POLYNOMIAL EXPANSIONS IN KINETIC THEORY OF GASES. Kumar, Kailash (Australian National Univ., Canberra). Ann. Phys. (N. Y.), 37: 113-41 (Mar. 1966).

Three systems of polynomials, introduced in kinetic theory by Burnett (Chapman and Cowling), by Grad, and by Ikenberry and Truesdell have been studied with a view to

shortening the algebraic work involved. Considerations of irreducibility show that the system suggested by Burnett and based on the Sonine polynomials is the most economical. Its effectiveness can be enhanced by a systematic notation based on the algebra of irreducible tensors as developed by Racah and others in connection with atomic and nuclear problems. In particular, certain transformations used by Talmi in connection with the harmonic oscillator shell model may be used to simplify the calculation of the collision integral. Each coefficient in a certain polynomial expansion of this integral is expressed as a product of two Talmi coefficients, an integral involving the dynamics of collision and some moments of the distribution function. The solution of the eigenvalue problem of the linearized collision operator for Maxwellian molecules follows as a simple consequence. An algebraic interpretation and discussion of the properties of Talmi transformation coefficients are given. (auth)

25954 FLOW OF ELECTRICALLY CONDUCTING FLUID WITHIN A TRAVELING FIELD IN A CHANNEL WITH METALLIC WALLS AND A VELOCITY DISTRIBUTION DESCRIBABLE BY A POWER OF THE GAP WIDTH. Tolmach, I. M.; Dovorchik, S. E. Izv. Akad Nauk SSSR, Energ. Transp., No. 1, 107-12(1965).

The one-dimensional flow of electrically conducting fluids within a traveling magnetic field in a channel with insulating walls and a velocity distribution of the fluid describable by a power of the gap width was studied previously. The calculation for a channel having metallic walls of finite thickness and electric conductivity is repeated. The traveling field is generated by coils placed within the grooves of the magnetic circuit having an infinite magnetic permeability. The velocity is symmetric with respect to the median plane of the channel and is given by the expression $V_x = V_{max}(1 - z/\Delta)^m$, where Δ is half the width of the gap, while V_{max} and m are constants. Under these assumptions the expressions for voltages, currents, and Joule losses within the liquid metal and the metallic walls, as well as for the total power consumed and the efficiency were derived. The simultaneous interactions between the fluid, walls, and the nonconducting layers were considered. (ATD)

25955 FLUID MOTION NEAR THE PHASE INTERFACE IN THE PRESENCE OF ELECTROMAGNETIC FIELD. Ivanov, U.; Mikhailov, Yu. A. (Inst. of Power Engineering, Academy of Sciences, Latvian SSR). Latv. PSR Zinat. Akad. Vestis, Fiz. Tek. Zinat. Ser., No. 1, 3-15(1966). (In Russian).

An approximate mathematical model of the double layer is given. General characteristics of its structure are considered. On the basis of this model equations of fluid motion near the fluid-fluid interface and the fluid-solid body interface are solved. The velocity of relative motion of contacting phases in the presence of electromagnetic field is given. The characteristics of fluid motion under the influence of electric and magnetic fields near the interface are indicated. Physical nature of the notion "skidding surface" is disclosed and the method of its numerical calculation is presented. The parameter $\sqrt[3]{\rho_1\eta_1/\rho_2\eta_2}$ was employed in characterizing the interphase interaction. (auth)

25956 MAGNETOHYDRODYNAMIC FLOW IN CONVERGENCE CHANNEL. Glasov, O. (Inst. of Power Engineering, Academy of Sciences, Latvian SSR). Latv. PSR Zinat. Akad. Vestis, Fiz. Tek. Zinat. Ser., No. 1, 16-21(1966). (In Russian).

Two-dimensional laminar MHD flow in the convergence channel in the presence of uniformity of the flow in the input is considered. Solutions were obtained by the one-parameter integral method using the Hartmann profile in the boundary layer. The flow convergence influence on the development of the boundary layer for any value of the magnetic field induction is shown. The values of the current leakage flow in the boundary layer are given. (auth)

25957 BOUNDARY LAYER OF A CONDUCTING MEDIUM IN A MAGNETIC FIELD. Kitanin, E. L.; Sokovishin, Yu. A. Magnit. Gidrodin., No. 1, 47-50(1966). (In Russian).

A numerical solution of the problem of conducting gas flow near a flat plate for a power-law distribution of the external flow velocity is presented. The peculiarity of the solutions of this type is the possibility of unseparable flow for $\beta < -0{,}1988$ and strong magnetic fields. The region of existence of the unseparable flow for various values of MHD-interaction parameter is shown. An approximate solution for large values of this parameter is given. (auth)

25958 MAGNETOELASTIC FLUTTER. Kiselev, M. I. Magnit. Gidrodin., No. 1, 51-4(1966). (In Russian).

The instability of incompressible nonconducting fluid flow in a thin cylindrical conducting elastic pipe in the presence of a constant uniform magnetic field parallel to the axis of the pipe is investigated in the one-dimensional approximation. The effects of viscosity and induced magnetic field are neglected. (auth)

25959 GENERAL SOLUTION OF THE MHD EQUATIONS FOR NONSTATIONARY ONE-DIMENSIONAL AND STATIONARY TWO-DIMENSIONAL FLOW. Golitsyn, G. S.; Dzhuzumkulov, T.; Stanyukovich, K. P. Magnit. Gidrodin., No. 1, 65-73(1966). (In Russian).

The general solution of the MHD equations is examined for a gas with perfect conductivity in the case of nonstationary one-dimensional and stationary two-dimensional flow in the presence of transverse magnetic field. (auth)

25960 TRANSIENT REGIMES OF FLOW IN MAGNETOHYDRODYNAMICS. Vulis, L. A.; Fomenko, B. A. Magnit Gidrodin., No. 1, 74-84(1966). (In Russian).

Qualitative singularities of conducting liquid channel flow in the transition region between the laminar and turbulent regimes of flow at $Re_m \ll 1$ in the presence of a magnetic field are discussed. Interpolation formulas for the friction coefficient as a function of the Reynolds and Hartmann numbers are considered. Theoretical data are compared with the experimental results. (auth)

25961 MHD FLOW OF A VISCOUS CONDUCTING LIQUID IN CHANNELS, TAKING INTO ACCOUNT THE FINITE CONDUCTIVITY OF THE WALLS. Sych, V. M. Magnit. Gidrodin., No. 1, 85-92(1966). (In Russian).

The steady flow of a conducting liquid in rectangular ducts with arbitrary wall conductivity in transverse magnetic field is studied, using the direct variational method. The obtained results are used particularly for the determination of viscous and ohmic losses in an MHD converter. (auth)

25962 VISCOUS CONDUCTING FLUID FLOW INDUCED BY ROTATING DISC IN THE PRESENCE OF AXIAL MAGNETIC FIELD. Shidlovskii, V. P. Magnit. Gidrodin., No. 1, 93-7(1966). (In Russian).

The magnetohydrodynamic problem of the motion of a viscous conducting fluid near a rotating disc in the presence of an axial magnetic field is considered. A solution is derived by means of linearization with respect to the parameter characterizing the magnetic field strength, using the method of integral relations. (auth)

25963 ON THE APPLICATION OF PITOT AND PRANDTL TUBES IN AN MHD EXPERIMENT. Branover, H. H.; Gel'fgat, Yu. M.; Tsinober, A. B.; Shtern, A. H.; Scherbinin, E. V. Magnit. Gidrodin., No. 1, 98-102 (1966). (In Russian).

A qualitative analysis is carried out of the differential equations of spatial MHD flow near the forward critical point in the presence of magnetic fields with large induction. It is shown that, in these conditions, the flow asymptotically approaches plane flow and the pressure at the forward critical point increases. The upper limit of the Stewart number was determined experimentally, up to which the effect of the field on the pressure at the forward critical point of the streamlined body can be neglected, i.e., the limits of the use of Pitot and Prandtl tubes without preliminary calibrations according to the magnetic field were established. (tr-auth)

25964 THE INFLUENCE OF BUSBARS ON INTERACTION BETWEEN CONDUCTING FLUID FLOW AND TRAVELING MAGNETIC FIELD. Kushnir, V. S.; Morozova, N. M.; Pichakhchi, L. D. Magnit. Gidrodin., No. 1, 109-15(1966). (In Russian).

The effect of electrically conducting side walls (busbars) on the interaction of a current of conducting liquid with a traveling magnetic field created by a long line with concentrated inductances and capacitances is examined. An expression for the coefficient of amplification of the line as a function of the ratio of the busbar thickness and the channel width to the wavelength is obtained. An expression for the coefficient of amplification is also obtained for the case when the busbars are separated from the current of conducting liquid by a narrow layer whose conductivity is on the same order as that of the liquid. The conditions under which the effect of the layer can be neglected are found. (tr-auth)

25965 AXIAL MOTION OF CONDUCTING LIQUID IN PRESENCE OF RADIAL MAGNETIC FIELD. Dickii, G. P. Magnit. Gidrodin., No. 1, 151-3(1966). (In Russian).

The flow of a viscous noncompressible conducting liquid in a channel bounded by two nonconducting coaxial cylinders and a pair of thin flat electrodes in a radial magnetic field is studied. The MHD equations for the induced axial magnetic field and the velocity of the liquid as functions of the channel radius are written, assuming the effect of the electrodes on the liquid flow to be negligible. Equations for the electric power, Joule heating, efficiency, and electric efficiency of the generator in terms of the pressure gradient, channel dimensions, Hartmann number, and load parameter are derived. Results of calculations of the efficiency as a function of the load parameter for various values of the Hartmann number are shown. (M.J.T.)

25966 STATIONARY MAGNETOHYDRODYNAMIC TRANS-FLOW PROBLEM. Forste, J. Monatsber. Deut. Akad. Wiss. Berlin, 7: No. 1, 1-6(1965).

Eleven equations were derived for the characterization of the stationary magnetohydrodynamic trans-flow problem pertaining to a three-dimensional Euclidean space filled with a noncompressible, electrically conducting fluid. (CFSTI)

25967 HALL CURRENTS IN MAGNETOHYDRODYNAMIC SHOCK WAVES. Leonard, B. P. (Cornell Univ., Ithaca, N. Y.). Phys. Fluids, 9: 917-26(May 1966).

The steady-state structure of magnetohydrodynamic shock waves in a slightly ionized gas is discussed. Both scalar and tensor conductivity cases are considered, and the magnetic diffusivity is taken to be much greater than both the viscous and thermal diffusivities. These properties lead naturally to the application of a singular perturbation technique for finding the structure of the magnetic layer, in which imbedded viscous and thermal sublayers may appear in the form of discontinuities. Numerical solutions are obtained for a variety of typical cases. Hall currents are found to give rise to a spiraling magnetic field component, whereas in scalar conductivity shocks the magnetic field remains in a single plane. (auth)

25968 MAGNETOHYDRODYNAMICS OF FLOW BETWEEN TWO COAXIAL TUBES. Uberoi, Mahinder S.; Chow, Chuen-yen (Univ. of Colorado, Boulder). Phys. Fluids, 9: 927-32(May 1966).

A current-carrying incompressible fluid confined between two axisymmetrically deformed nonconducting coaxial tubes is considered. Two problems are solved by assuming small magnetic Reynolds numbers and small wall deformations. In the first problem the motion of a stagnant viscous fluid is caused by the electric current carried by the fluid and the current flowing in a central conductor since in this case the electromagnetic force is rotational and cannot be balanced by the pressure gradient which is potential. In the second problem the motion of a flowing inviscid fluid is modified by the applied currents. At the places where the outer tube contracts, the inner streamtubes expand as if the outer tube had expanded. This is due to the fact that, in this case also, electromagnetic force is rotational. The results show that if the current density in the fluid remains constant, the electromagnetic effect on the fluid motion caused by the deformation of the outer tube is reduced in the presence of a cylindrical inner tube. A current in the central conductor flowing in the same direction as that in the fluid magnifies, and that in the opposite direction retards the fluid motion. The influence of the deformation of the inner tube is similar to but smaller than that of the outer tube. (auth)

25969 FLOW AROUND A NONCONDUCTING SPHERE IN A CURRENT-CARRYING FLUID. Chow, Chuen-yen (Univ. of Notre Dame, Ind.). Phys. Fluids, 9: 933-6(May 1966).

The creeping flow caused by a nonconducting sphere in an incompressible, viscous fluid carrying an otherwise uniform electric current is investigated analytically. For a stationary sphere the fluid motion is found to be induced from the upstream and downstream directions of the current toward a plane which passes through the center of the sphere and is perpendicular to the current at infinity. For a sphere moving slowly in a direction parallel to the current far away, a reverse-flow region is formed behind the body. It is also found the electromagnetic field does not affect the drag of a moving sphere. (auth)

25970 VELOCITY DISTRIBUTION OF THE ELECTRONS IN AN IONIZED GAS IN THE PRESENCE OF A HOMOGENEOUS ALTERNATING ELECTRIC FIELD. Desloge, Edward A. (Florida State Univ., Tallahassee). Phys. Fluids, 9: 982-8(May 1966).

The velocity distribution of the electrons in an ionized gas in the presence of a homogeneous alternating electric field is approximated as a function of the electron density n, the electron temperature τ, the electric current density J, and the thermal current density Q. The equation of change is then used to obtain four equations in the four unknowns n, τ, J, and Q. The effects of recombination, ionization, elastic and inelastic collisions are included. (auth)

25971 IONIZING SWITCH-ON SHOCK WAVES. Gross, R. A.; Levine, L.; Geldon, F. (Columbia Univ., New York). Phys. Fluids, 9: 1033-5(May 1966).

A physical model is presented for the development of a uniquely determined ionizing shock wave and associated electric field in a coaxial electromagnetic shock tube. Numerical solutions of the jump conditions are given. (auth)

25972 CAPILLARY INSTABILITY OF A JET CARRYING AN AXIAL CURRENT. Nayyar, N. K.; Trehan, S. K. (Goddard Space Flight Center, Greenbelt, Md.). Phys. Fluids, 9: 1035-7(May 1966).

The inclusion of Hall current in Ohm's law leads to overstability for vericose deformation (m = 0) in the case of a capillary jet carrying axial volume current. (auth)

25973 ELECTRIC CURRENT DENSITY IN AN IONIZING LAYER. Rosciszewski, Jan (Convair Div., General Dynamics Corp., San Diego, Calif.). Phys. Fluids, 9: 1040-2(May 1966).

The expression for current density was derived using multifluid equations of conservation of momentum and mass for the gas with the finite rate of ionization in a collision dominated regime ($\omega_i \tau_i < 1$). (auth)

25974 FREE-STREAMING AND LANDAU DAMPING. Gunshor, R. L. (Rensselaer Polytechnic Inst., Troy, N. Y.). Phys. Fluids, 9: 1044-5(May 1966).

A simple technique is used to express the ballistic or free-streaming response implicit in Landau's theory. In a gas characterized by Coulomb interactions, this response is shown to be equivalent to the free-streaming of noninteracting particles. (auth)

25975 COLLECTIVE MOTION IN LIQUID ARGON. Desai, Rashmi C.; Nelkin, Mark (Cornell Univ., Ithaca, N. Y.). Phys. Rev. Lett., 16: 839-41(May 9, 1966).

Independent evidence is presented, showing that the observed inelastic peaks in the energy distribution of slow neutrons scattered by liquid argon are a real manifestation of collective motion. (B.G.D.)

25976 SOME PROBLEMS RELATED TO THE NONSTEADY MOTION OF A VISCOUS FLUID IN A MAGNETIC FIELD. Sidlovski, V. P. Stud. Cercet. Mec. Apl., 16: 1009-19(1964). (In Russian).

The motion of an incompressible viscous fluid, in the presence of a steady magnetic field, was examined for two cases. The first case refers to the fluid flow about a non-finite cylinder, which starts rotating suddenly at the instant $t = 0$ at a constant angular speed in a steady magnetic field whose components are H_r and H_θ. The equations of the problem are: $\gamma\{(1/r)(\delta/\delta r)[r(\delta v/\delta r)] - k^2 v - \alpha^2 (v/r^2)\} = \delta v/\delta t$ and $\delta p/\delta r = \rho(v^2/r)$, with the initial and boundary conditions. The second case examines the axial flow of the fluid between two concentric cylinders in a steady magnetic field under the action of a pressure gradient, assuming that the constant pressure gradient dp/dz is suddenly applied at the instant $t = 0$. The equation of the problem is: $(1/r) - (\delta/\delta r)[r(\delta u/\delta r)] - n^2 u - \beta^2(u/r^2) = -4c + (1/\gamma)(du/dt)$, with the initial condition $u = u$ for $t = 0$. (Rum. Sci. Abstr.)

25977 SOME INTERFERENCE EFFECTS DUE TO THE MIXING OF QUANTUM LEVELS BY EXTERNAL FIELDS. Lyuboshits, V. L.; Onishchuk, V. A.; Podgoretskii, M. I. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 3: 582-9(Mar. 1966). (In Russian).

Interference effects are considered occurring in external fields, when the quantum levels of atomic and nuclear systems are mixed. In particular, it is shown that in magnetic fields unpolarized nuclei can emit circularly polarized γ quanta. The influence of external fields on the dynamic properties of the electric and magnetic susceptibility of gas under low pressure is considered. (auth)

25978 EFFECT OF A STANDING SOUND FIELD ON THE MAGNETOHYDRODYNAMIC FLOW PAST A FLAT PLATE. Gupta, Anadi Shankar (Indian Inst. of Tech., Kharagpur). Z. Angew. Math. Phys., 17: 260-6(1966).

The effect of a standing sound field on the flow of an electrically conducting liquid past an infinite flat plate in the presence of a uniform transverse magnetic field is theoretically investigated. (L.B.S.)

25979 PROPAGATION OF MAGNETOHYDRODYNAMIC SIMPLE WAVES. Gundersen, Roy M. (Univ. of Wisconsin, Milwaukee). Z. Angew. Math. Phys., 17: 337-40 (1966).

A new solution for the propagation of fast and slow magnetohydrodynamic simple waves is given. The investigation treats certain known gas dynamics results as special cases. (tr-auth)

25980 SURFACE TENSION AND BUOYANCY EFFECTS IN THE CELLULAR CONVECTION OF AN ELECTRICALLY CONDUCTING LIQUID IN A MAGNETIC FIELD. Nield, Donald A. (Univ. of Auckland, N. Z.). Z. Angew. Math. Phys., 17: 131-9(Jan. 1966).

An extension of buoyancy and surface tension studies is made to include the effects of a magnetic field. In the model considered the lower surface of the liquid is assumed to be a rigid horizontal plane which is thermally conducting and at a uniform temperature. The upper surface remains plane. The effect of surface tension on the normal stress condition is neglected, and the tangential viscous stress is balanced by the traction due to the variation with temperature of surface tension. The mean temperature of this surface is assumed constant, but the perturbation temperature is allowed to satisfy a general radiation condition. The critical values of the Marangoni and Rayleigh numbers, and the corresponding wave numbers for insulting and conducting free surfaces are given. (J.F.P.)

25981 MAGNETOHYDRODYNAMIC DUCT FLOW UNDER CIRCULAR AND RADIAL MAGNETIC FIELDS. D'Sa, Edward R. Z. Angew. Math. Phys., 17: 140-56 (Jan. 1966).

Steady magnetohydrodynamic flow in a duct under a uniform field is studied when the duct section is an annular sector and the impressed field is circular or radial. The equations are linear, and the investigation is confined to the usual limiting cases of perfectly conducting or insulating walls. The fluid is assumed to be incompressible, viscous, conducting, and of constant properties. (J.F.P.)

25982 MAGNETOGASDYNAMIC FLOW PATTERNS. Cap, Ferdinand; Friedel, Helmut (Innsbruck Univ.). Z. Angew. Math. Phys., 17: 183-8(Jan. 1966).

Two-dimensional MGD problems are solved in analogy with the Prandtl-Busemann method of gasdynamics, e.g., the net of Mach lines (characteristics) can be determined in the flow plane. This method is also evaluated numerically. (J.F.P.)

25983 APPROACH TO STATISTICAL EQUILIBRIUM IN A SOLUBLE MODEL. Lopez, A. (Univ. of Vienna). Z. Phys., 192: 63-80(1966).

The soluble model of an oscillator coupled to a scalar field is used to describe the Brownian motion of an oscillator in a thermal bath. The approach to equilibrium is shown by studying the generating functional that corresponds to a nonequilibrium situation fixed as an initial condition. It is shown how this functional goes over into the functional associated with the equilibrium situation. The solution of the functional equations is discussed. (auth)

25984 THEORY OF THE HYDROMAGNETIC DYNAMO. Pichakhchi, L. D. (Inst. of Thermal Physics, Academy of Sciences, Siberian SSR). Zh. Eksp. Teor. Fiz., 50: 818-20 (Mar. 1966). (In Russian).

The Cowling theorem regarding the impossibility of a stationary axial-symmetric hydromagnetic dynamo is formulated as a theorem of impossibility of a short-circuited axial-symmetric dynamo. A hydromagnetic dynamo with a zero electric field is termed as being short circuited. Formulated in this way the Cowling theorem can be extended to an arbitrary three-dimensional case. It is concluded that generation of a magnetic field in the stationary case must necessarily involve separation of the electric charges in the fluid; in other words along with the magnetic field an electric field must also appear in space. (auth)

25985 PROPAGATION OF AN INITIAL PULSE IN RELATIVISTIC MAGNETOHYDRODYNAMICS WITH FINITE CONDUCTIVITY. Zhumartbaev, M. T. Zh. Prikl. Mekh. Tekh. Fiz., No. 4, 143-5(July-Aug. 1965). (In Russian).

The problem of propagation of a small amplitude pulse in a relativistic magnetohydrodynamic medium is considered. In contrast to the nonrelativistic problem where the displacement currents are neglected, the Alfven and magnetoacoustic wave cannot always be separated. The problem is treated using a closed set of relativistic magnetohydrodynamic equations. The equations are linearized and all field quantities are given as the superposition of moving waves. The dispersion relation is obtained which for infinite conductivity can be separated into Alfven and magnetoacoustic waves. The small conductivity case is also considered and a more complex dispersion relation is obtained. (CFSTI)

25986 TWO-DIMENSIONAL FLOW OF AN IDEAL CONDUCTING GAS IN CROSSED ELECTRIC AND MAGNETIC FIELDS. Vysotskaya, I. V.; Genkin, A. L.; Zhukovskii, M. I. Zh. Prikl. Mekh. Tekh. Fiz., No. 5, 40-4(Sept.-Oct. 1965). (In Russian).

The flow of a two-dimensional, ideal, variable-conductivity gas is analyzed, using an approximation technique. The coordinate system for the problem is shown. All Hall effects are neglected, the applied fields are assumed to be constant, and the electric conductivity is a function of pressure and temperature. The governing hydromagnetic equations are expanded in powers of the magnetic Reynolds number and the interaction parameter. The resulting set of equations is given up to second order in z where z represents the various flow parameters and expressions are derived for u_1, p_1, B_{x2} and B_{y2}. An analogous solution can be obtained in the xz-plane. (ATD)

25987 AN ESTIMATE OF THE FRONT THICKNESS OF STRONG SHOCK WAVES IN GASES. Stupochenko, E. V. Zh. Prikl. Mekh. Tekh. Fiz., No. 6, 116-18(Nov.-Dec. 1965). (In Russian).

In hydrodynamics of ideal fluids, the shock wave is represented by a geometrical discontinuity surface of hydrodynamic and thermodynamic quantities. However, the incorporation into the theory of viscosity and of heat conduction widens the transition region to a layer of finite

thickness. The estimate of this thickness Δx using Navier-Stokes equation gives an approximate answer $\Delta x \approx l_0$ where l_0 is the mean free path. Since the equations of macroscopic aerodynamics are valid only for the $\Delta x \to 0$ limit, it is of considerable interest to give a more reliable estimate using Boltzmann's equation and its H-theorem (avoiding the actual solution of the kinetic equation) and the expression $nr_0^2 \Delta \approx 1$ is obtained where n is particle density and r_0 is the effective radius of the intermolecular forces. (ATD)

Geophysics

Refer also to abstracts 25303, 25709, 25751, and 25754.

25988 (LA–3439) GRAPHS OF CALCULATIONS OF ENERGY DEPOSITION AND AIR FLUORESCENCE FROM RADIATION PRODUCED BY A NUCLEAR EXPLOSION IN SPACE. Bennett, E. W. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). Nov. 1965. Contract W-7405-eng-36. 53p. Dep. mn. CFSTI $3.00 cy, $0.50 mn.

Results of calculations of energy deposition in the atmosphere and air fluorescence produced by x rays from a hypothetical nuclear explosion at an altitude of 10^5 km are presented in graphical form. The calculations were done for many parameters with the intent that the results would be useful in the detection of nuclear explosions in space, for example in systems design and signal interpretation, and in the prediction of atmospheric effects brought about by a high-altitude nuclear explosion. The machine codes used in performing the calculations are described briefly. In all cases an x-ray yield of 1 kt was assumed. Deposition calculations were done for a variety of source temperatures and incident proton energies ranging from a low temperature of 0.1 kev to a high temperature of 10 kev and for photon energies of 100 kev and 1 Mev. Deposition per unit volume as a function of altitude directly above a ground-based observer is presented for two cases: (1) burst at zenith, and (2) burst on the horizon. In the zenith case, the peak deposition varies only slightly with source temperature or photon energy, ranging between 2×10^{-15} and 0.8×10^{-15} joules cm^{-3}. The altitude of peak deposition, however, changes from 108 km for the 0.1 kev source to 80 km for the 1-kev source and 24 km for the 1-Mev photon source. For burst on the horizon, the peak deposition is lower by about two orders of magnitude, varying slightly about a value of 10^{-17} joules cm^{-3}, while the altitude of peak changes from 145 to 100 to 50 km for the 0.1-kev, 1-kev, and 1-Mev sources, respectively. Air fluorescence calculations were done for a variety of source temperatures, detector fields of view, and burst directions as seen by an observer on the ground. An x-ray energy deposition conversion to fluorescence radiation efficiency of 1.4% was used. Graphs of the incident flux density as a function of time from 10 μsec to 250 μsec are given for burst locations ranging from zenith to 80° from zenith for detectors with fields of view 90°, 120°, and 160° in diameter, for a source temperature of 1 kev. Depending on burst location and field of view, the peak varies from a high of 8×10^{-8} W cm^{-2} to a low of 2.5×10^{-9} W cm^{-2}. Space-resolved and time-resolved plots of the air fluorescence apparent surface brightness as seen from the ground are presented for several burst locations. Peak brightnesses vary from 1.5×10^{-6} W cm^{-2} $ster^{-1}$ to 5×10^{-9} W cm^{-2} $ster^{-1}$ with typical values lying between 5×10^{-7} and 5×10^{-8} W cm^{-2} $ster^{-1}$. (auth)

25989 (NASA-SP-3024(Vol.2)) MODELS OF THE TRAPPED RADIATION ENVIRONMENT. VOLUME II. INNER AND OUTER ZONE ELECTRONS. Vette, James I.; Lucero, Antonio B.; Wright, Jon A. (Aerospace Corp., El Segundo, Calif.). 1966. Contract AF04(695)-469. 91p. CFSTI $1.00 cy, $0.75 mn.

The electron environment AE2, which covers both inner and outer zone out to L = 6.0 for the time period around August 1964, is described. A comparison of the model with existing data is presented, along with a detailed listing of both the flux distribution and energy spectrum. The orbital integration results for circular orbits up to 18,000 n. miles are given for 29 energies and energy bands. Similar results are also presented for an electron environment projected to the end of 1968. (M.O.W.)

25990 MODEL OF FERMI ACCELERATION AT SHOCK FRONTS WITH AN APPLICATION TO THE EARTH'S BOW SHOCK. Jokipii, J. R. (California Inst. of Tech, Pasadena). Astrophys. J., 143: 961-79(Mar. 1966).

A model of first-order Fermi acceleration at stock fronts is developed. A hydromagnetic shock is assumed to be propagating toward an isolated magnetic mirror in an otherwise uniform magnetic field which is not parallel to the shock front. The behavior of an ensemble of particles trapped between the mirror and the shock is studied, and a description of the balance of particle injection into the trapping region, loss through the shock or mirror, and energy gain is obtained. Injection criteria are discussed, and an attractive source of particles eligible for acceleration is shown to be the quasi-thermalized plasma behind the shock, a small fraction of which may leak out in front of the shock and be accelerated. Application of the model to the earth's bow shock leads to an attractive model for the energetic electron pulses which have been observed outside of the magnetosphere. If a small fraction of the ~1-kev electrons in the quasi-thermalized plasma behind the shock escape to the region in front of the bow shock, many quantitative features of the observed pulses are explained by a model in which each pulse is due to the acceleration of these electrons by a mirror approaching the bow shock. In particular, the observed cutoff in >30-kev pulses a few earth radii beyond the shock is readily explained. The model predicts, further, that the cutoffs for more energetic particles should be at smaller distances from the shock. The observed energy spectra are in excellent agreement with the model. Some critical observations are suggested. (auth)

25991 SURFACE WAVES ON THE MAGNETOSPHERIC BOUNDARY AS A POSSIBLE ORIGIN OF LONG-PERIOD GEOMAGNETIC MICROPULSATIONS. Atkinson, Gerald; Watanabe, Tomiya (Univ. of British Columbia, Vancouver). Contract Nonr 3116(00). Earth Planet. Sci. Lett., 1: 89-91(Mar. 1966).

An excitation mechanism is proposed for hydromagnetic oscillations in the magnetosphere. Previous work suggests that the long-period geomagnetic micropulsations are due to these hydromagnetic oscillations. (J.F.P.)

25992 IONOSPHERIC EFFECTS OF NUCLEAR EXPLOSIONS: HIGH ALTITUDE EXPLOSIONS. Saha, A. K.; Mahajan, K. K. (National Physical Lab., New Delhi, India). Indian J. Pure Appl. Phys., 4: 117-23(Mar. 1966).

The ionospheric effects observed over Delhi following three Russian high-altitude nuclear explosions in Central Asia on 22 Oct., 28 Oct., and 1 Nov., 1962, and two high-altitude explosions at Johnston Island by the USA on 26 Oct. and 1 Nov., 1962, are described and compared with those from the low-altitude megaton-range Novaya Zemlya explosions reported earlier. It is observed that broadly the D and F_2 regions are affected by high-altitude explosions and that the effects are significantly different from those observed in the case of the Novaya Zemlya explosions. No effects could be observed for the D region with the atmospherics recorder at 27 and 100 kc, indicating that the height range affected in these explosions is higher than that in the case of the Novaya Zemlya explosions. The Central Asia explosions caused increases in the heights of maximum ionization of the F layer simultaneous with decreases in the ionization levels at various heights, while no significant change in the F-layer height or distortion of the shape could be noted in the case of Johnston Island explosions, except for an increase in the ionization levels at various heights. The possible mechanisms causing the D-region and F_2-region effects for both the Central Asia and Johnston Island explosions are discussed. (auth)

25993 HELIUM WHISTLER OBSERVED IN THE CANADIAN SATELLITE ALOUETTE II. Barrington, R. E.; Belrose, J. S.; Mather, W. E. (Defence Research Telecommunications Establishment, Ottawa). Nature, 210: 80-1(Apr. 2, 1966).

A very low-frequency receiver of the Alouette II was designed with a sensitivity down to 50 cps in order to determine whether helium whistlers could be detected. Proton and helium whistlers were observed on the records from the southern hemisphere, which were analyzed in detail to yield the number density of protons and helium ions at the satellite. The crossover frequencies were measured and used to derive the relative abundances of O^+, He^+ and H^+ ions. It is concluded that the simultaneous observation of proton and helium whistlers provides a direct and accurate means of measuring the composition and electron density of ionosphere at great heights above the earth's surface. (L.B.S.)

25994 EXCITATION OF BACKWARD DOPPLER-SHIFTED CYCLOTRON RADIATION IN A MAGNETO-ACTIVE PLASMA BY AN ELECTRON STREAM. Fung, P. C. W. (Univ. of Tasmania, Commonwealth of Australia). Planet. Space Sci., 14: 335-46(Apr. 1966).

The radiative instability of an electron-stream magneto-active plasma system is investigated for a cold ambient plasma and a helical electron stream which has a delta function momentum distribution. Using parameters appropriate to the earth's exosphere, the growth rate of backward Doppler-shifted cyclotron radiation is evaluated numerically as a function of the emission or wave normal angle θ. It is shown that the rate of growth is maximum for $\theta = 180°$ and that only frequencies close to that emitted at $\theta = 180°$ are amplified appreciably. The application of the theory to VLF discrete emission is discussed. (auth)

25995 NOTE ON THE REFLECTION AND REFRACTION OF DAMPED MAGNETODYNAMIC WAVES IN THE IONOSPHERE. Hruska, Antonin (Inst. of Geophysics, Prague). Studia Geophys. Geodaet., Cesk. Akad. Ved, 9: No. 1, 53-60(1965).

The propagation of damped waves in a weakly ionized gas of zero temperature is investigated assuming a density discontinuity. Formulas are derived for the intensities of the reflected and refracted electromagnetic waves. It is demonstrated that the laws of reflection and refraction are influenced essentially by dynamic interaction between ions or electrons and neutral particles. (CFSTI)

25996 EFFECTS OF NUCLEAR AND IONIZING RADIATION ON THE PHYSICO-CHEMICAL PROCESSES AFFECTING NITRIC ACID FORMATION AND DISINTEGRATION IN AIR. Dmitriev, M. T. Tr. Nauch.-Issled. Inst. Gidrometeorol. Priborostr., 13: 80-98(1965). (In Russian).

The physical-chemical processes leading to the formation and decomposition of nitric acid under the effects of ionizing radiation originating naturally in the upper atmosphere during a series of atmospheric phenomena, ionization of air, and the effects of radioactivity are reported. It was found that formation of the oxide and dioxide of nitrogen in air depends on the ionization of nitrogen, formation of nitrous oxide, dissociation of oxygen, and decomposition of nitric oxide with processes of electron excitation. (tr-auth)

25997 HANDBOOK OF GEOPHYSICS AND SPACE ENVIRONMENTS. Valley, Shea L. (ed.). New York, McGraw-Hill Book Company, Inc., [1965]. 522p. $24.50.

A comprehensive collection of data, formulas, definitions, and theories about the earth's environment is presented. Geodesy, gravity, model atmosphere, atmospheric temperature, density, pressure, and moisture, winds, precipitation, clouds, and aerosols are covered. Also covered are atmospheric composition, electricity, and optics, some aspects of electromagnetic wave propagation, transmission and detection of infrared radiation, the geomagnetic field, ionospheric physics, airglow, auroras, and meteoritic phenomena. Other topics are the sun, solar electromagnetic and corpuscular radiation, interplanetary space and the solar atmosphere, the lunar and planetary environments, astrophysics, astronomy and radio astronomy. (J.F.P.)

Gravitation, Quantum Mechanics, and Relativity Theory

Refer also to abstracts 25678, 25679, 25681, 25784, 25810, and 26137.

25998 (DESY–66/6) CURRENT COMMUTATION RELATIONS IN THE FRAMEWORK OF GENERAL QUANTUM FIELD THEORY. Schroer, B. (Hamburg Univ. (West Germany). II. Institut fuer Experimentalphysik); Stichel, P. (Physikalisches Staatsinstitut, Hamburg (West Germany). Deutsches Elektronen-Synchroton, Hamburg (West Germany)). Feb. 1966. 44p. Dep. mn.

A rigorous formulation of Gell-Mann's equal time commutation relations is given in the framework of general quantum field theory. It is shown that sum rules of the Adler-Weisberger type can be derived without making any additional assumptions on the high-energy behavior of amplitudes. Two different methods of derivation are discussed, the first one is an improved version of the Fubini-Furlan method, the second one avoids the application of the Gauβ-Theorem and uses the Jost-Lehmann-Dyson-representation directly for the commutator of currents. In neither case does one get a dependence on the frame of reference. (auth)

25999 DETAILED ANALYSIS OF SOME PROPERTIES OF THE JWKB-APPROXIMATION. Froeman, Nanny (Univ. of Uppsala). Ark. Fys., 31: 381-408(1966).

The properties of the JWKB-approximation in a classically allowed and in a classically forbidden region of the real axis as well as the properties of the usual connection formulas are analyzed in detail by means of a method developed earlier by N. Fröman and P. O. Fröman. It is pointed out that in a classically forbidden region there are restrictions on the validity of the JWKB-approximation even in intervals lying far from classical turning points. Already these restrictions require that the connection formulas be one-directional. The impossibility of using the connection formulas in both directions, as is often done in textbooks, is further confirmed in a direct and obvious way. The inferences that can be drawn from the continuity equation are discussed in detail, and it is clearly shown that the fulfilment of the continuity equation can never justify the use of the connection formulas in the forbidden directions. The investigation is illustrated by numerical results for the special case of a Coulomb potential. (auth)

26000 KINEMATICS OF PARTICLES WITH IMAGINARY MASS. Ferretti, I.; Verde, M. (Univ., Turin). Atti Accad. Sci. Torino: I. Cl. Sci. Fis., Mat. Natur., 100: 317-26(1965-66). (In Italian).

The kinematics of free particles whose four-momentum square ($P^2 = -m^2$) is negative is generally neglected in all theoretical treatments because it does not have an immediate physical significance. In quantum theory however the dynamic configuration relative to physical values of observables are largely conditioned by the analytical behavior of wave functions for complex values of quantum numbers. The free states in quantum mechanics are considered for two particles for having purely imaginary mass. (tr-auth)

26001 ELEMENTARY PROPERTIES OF NESTED HILBERT SPACES. Grossmann, Alexander (New York Univ.). Commun. Math. Phys., 2: 1-30(1966).

Detailed derivations are given of the simplest properties of nested Hilbert spaces and of operators between them. (auth)

26002 C*-ALGEBRAS OF CANONICAL SYSTEMS. I. Louplas, G.; Miracle-Sole, S. (Univ., D'Aix-Marseille). Commun. Math. Phys., 2: 31-48(1966). (In French).

The "twisted convolution" associated with the Weyl form of the canonical commutation relations for n degrees of freedom is described using ordinary convolution on a nilpotent central extension of additive phase space by the one-dimensional torus. Twisted convolution determines several C* algebras of quantum mechanical observables amongst which the algebra $L_2(E,\sigma)$ consisting of the L_2-functions on phase space and mapped isometrically onto the Hilbert-Schmidt-operators by the Schrödinger representation is especially studied. "Phase space quantum mechanics" is considered from the point of view of twisted convolution: the Wigner-Moyal formalism and the entire function formalism of Bargmann and Segal. (auth)

26003 EMBEDDING OF A RELATIVISTIC CHARGED PARTICLE. SOLUTION WITH A REAL SINGULARITY

INTO A PSEUDO-EUCLIDEAN SPACE. Efinger, Helmut J. (Vienna Univ. Univ. of Georgia, Athens). Commun. Math. Phys., 2: 55-8(1966).

A charged particle following the Reissner-Weyl vacuum field distribution shows in its interior a real singularity (the matter tensor becomes infinite). By embedding the interior submanifold $ds^2 = g_{11} \cdot dr^2 + g_{00} \cdot dt^2$ into a pseudo-Euclidean space E_3: $ds^2 = dZ_1^2 + dZ_2^2 - dZ_3^2$ one finds that the embedded (r,t)-metric looks like a cone with the top lying in the Z_1, Z_2 plane. The general formulas of embedding the complete manifold into a pseudo-Euclidean space E_6 are discussed. (auth)

26004 EXACT SOLUTION FOR UNIFORMLY ACCELERATED PARTICLES IN GENERAL RELATIVITY. III. SINGULAR EXPANDING (CONTRACTING) NULL SURFACE. Swaminarayan, N. S. (Univ. of Manchester, Eng.). Commun. Math. Phys., 2: 59-70(1966).

Recently an exact solution of Einstein's empty-space equations referring to four uniformly accelerated particles was given. The relation of this to static axially symmetric metrics of the Weyl and Einstein-Rosen classes is investigated. A physical interpretation of the singularity along half of the axis of symmetry of the uniformly accelerated metric in Weyl's form is given. An exact solution corresponding to an expanding (contracting) singular null surface is obtained by a limiting process from that for uniformly accelerated particles. (auth)

26005 ULTRARELATIVISTIC ESCAPE OF GAS IN A GRAVITATIONAL FIELD. Stanyukovich, K. P.; Gurovich, V. Ts. Dokl. Akad. Nauk SSSR, 165: 806-8(Dec. 1, 1965). (In Russian).

The motion of a gas at velocity close to that of light from the point of view of general relativity is considered in view of interest that attaches to this problem in connection with observations of quasars and explosions of galactic cores. The equations of motion and continuity previously obtained for the special relativity theory are modified, and the problem is simplified by assuming the initial distribution of the pressure and the velocity (the Cauchy problem) to the same form as used for self similar motion of ordinary gas. Although the final equation obtained cannot be solved analytically, it can be deduced, by examining the escape of an ultrarelativistic gas in an external Schwarzschild field, (scattering of the shell of a relativistic star after emergence of a shock wave traveling from the center to the surface), that the ultrarelativistic escape of initially homogeneous gas sphere behaves essentially like the motion of a gas in an external Schwarzschild field of a specific gravitational radius. (ATD)

26006 FLUCTUATION FORMULA FOR THE PHOTON NUMBER IN STATIONARY ELECTROMAGNETIC FIELDS. Kano, Y. (Univ. of British Columbia, Vancouver). Nuovo Cimento (10), 43B: 1-5(May 11, 1966).

The fluctuations of the photon number in stationary electromagnetic fields are investigated by the techniques of second quantization. The proton number operator in a local volume is defined. The operator describing the photon number in a local volume during a time interval T is also obtained. The fluctuation formula for the photon number per unit time is then derived. It is seen that the fluctuation formula for a large local volume takes the same form whether the density matrix satisfies only the stationary condition or a more stringent condition, the homogeneity condition. (auth)

26007 ROLE OF TETRAD AND FLAT-METRIC FIELDS IN THE FRAMEWORK OF THE GENERAL THEORY OF RELATIVITY. Davis, W. R. (North Carolina State Univ., Raleigh). Nuovo Cimento (10), 43B: 200-4(May 11, 1966).

Previous works introducing a second flat metric, in addition to the usual curved metric, into the formalism of the general theory of relativity are discussed; these works attempt to distinguish between inertial and permanent gravitational fields and thus to reinterpret Einstein's principle of equivalence. Attempts to give an extended physical role to the vector tetrad field and to formulate a unified field theory of electromagnetism and gravitation are mentioned. A natural connection between the two metric and the tetrad formalisms is pointed out, and the physical role played by tetrads in general relativity theory is discussed. It is shown how a decomposition of the gravitational-inertial field can be effected with respect to the local reference frame of an observer and the concomitant vector tetrad, thus eliminating deficiencies of previous formalisms — the arbitrariness of the association of the flat metric with the curved metric determined by Einstein's field equations and the insufficient definitiveness of the physical role of the flat metric. (M.J.T.)

26008 SURVEY OF THE HEITLER-ARNOUS NON-LOCAL FIELD THEORY. Guillot, J. C. (Institut Henri Poincare, Paris); Jaus, W.; O'Raifeartaigh, L. Proc. Roy. Irish Acad., Sect. A, 64: 93-105(Nov. 1965).

In some previous investigations of the nonlocal field theory of Heitler and Arnous it was found that this theory was convergent and gave a satisfactory explanation of all quantum-electrodynamic effects which were either non-relativistic or for which the radiative corrections could be neglected. It also gave a fairly satisfactory explanation of the mass differences of charge multiplets, at least as far as signs and orders of magnitude were concerned. It did not give satisfactory results for some effects, notably the photon self-energy and the magnetic moment of the electron, which involved relativistic radiative corrections. A survey of further investigations of this theory is given. These investigations show that the position with respect to the relativistic radiative corrections mentioned, and also with respect to the Lamb shift, is much better than was at first supposed, but that, in view of some improved experimental results, the theory still can not be brought into full agreement with experiment. This is because, in spite of predicting the correct radiative corrections (to order e^2) to the Lamb shift and the magnetic moment of the electron at rest, it implies a variation of the self-mass and magnetic moment of the electron with velocity, which is not in agreement with experiment. The overall conclusion is that the Heitler-Arnous approach is nonrelativistic but may be regarded as a nonrelativistic approximation to a future relativistic theory. It has the advantage of extending somewhat into the relativistic region and yields correctly some relativistic results. (auth)

26009 AFFINE FIELD LAWS. Oektem, Ferit (Dublin Inst. for Advanced Studies). Proc. Roy. Irish Acad., Sect. A, 64: 107-13(Jan. 1966).

A study is made of affine field laws based on the torsion tensor, its covariant derivative, and the curvature tensor. An affine connection is subjected a priori to tensor equations. Introducing Lagrange multipliers, a variational principle permits then the complete formulation of the field laws of the theory. Applications to general relativity, Einstein-Schrödinger unitary field theory, and others are given. (auth)

26010 THE EVOLUTION OF A SYSTEM OF GRAVITATIONALLY INTERACTING POINT MASSES. Zel'dovich, Ya. B.; Podurets, M. A. Soviet Astron. AJ (Engl. Transl.), 9: 742-9(Mar.-Apr. 1966).

Translated from Astron. Zh., 42: 963-73(Sept.-Oct. 1965).

The evolution of a system of heavy point particles is studied. The system evolves slowly through a sequence of quasi-equilibrium states, the properties of which are determined by the equations of equilibrium in general relativity (GR). It is shown that the evolution inevitably ends in a collapse. Effects leading to evolution are discussed: evaporation of particles and, specific to GR, emission of gravitational radiation and capture. The applicability of the results to astronomical objects is discussed. (auth)

26011 GRAVITATIONAL RADIATION OF DOUBLE STARS. Mironovskii, V. N. (Moscow State Univ.). Soviet Astron. AJ (Engl. Transl.), 9: 752-5(Mar.-Apr. 1966).

Translated from Astron. Zh., 42: 977-80(Sept.-Oct. 1965).

The spectral-density function of gravitational radiation of the galaxy for the period interval $0-1^d$ is obtained. The lower limit to the density of gravitational radiation in the universe is estimated. (auth)

26012 GRAVITATION AND FINITE RENORMALIZATIONS IN QUANTUM ELECTRODYNAMICS. Khriplovich, I. B. Yadern. Fiz., 3: 575-81(Mar. 1966). (In Russian).

A model, taking the gravitational interaction of electrons into account, leads to finite values of the electromagnetic self-energy and of the wave function renormalization constant. In first order with respect to e^2 the self energy is equal to 20% of the experimental mass. (auth)

26013 THE THREE-BODY PROBLEM. COMPLETE SYSTEM OF ANGULAR FUNCTIONS. Simonov, Yu. A. Yadern. Fiz., 3: 630-8(Apr. 1966). (In Russian).

The wave function describing a three particle system depends on two vectors—the differences between the particle coordinates. A method of constructing the complete system of wave functions, realizing irreducible representations of the three-particle permutation group, is given for any value of the angular momentum L. For L = 0 the system of functions is written explicitly. The system is labelled by the values of K—the global momentum in the six-dimensional space (K is an arbitrary even integer) and by the index v, which runs through the values between $-K/2$ and $K/2$ in jumps over two units. The symmetrical and antisymmetrical functions correspond to values of v, multiple to three. (auth)

26014 SYMMETRIZATION POSTULATE IN QUANTUM MECHANICALLY IDENTIFIED PARTICLES. Lueders, Gerhart (Univ., Goettingen, Ger.). Z. Phys., 192: 449-61(1966). (In German).

The symmetrization postulate in the sense of Messiah and Greenberg is proved under the following two assumptions: for each number of particles, one and only one irreducible representation of the symmetric group occurs in nature; and groups of particles do not influence each other, even not with respect to their permutation symmetry, if they are separated by big distances. (auth)

26015 BOUNDARY CONDITIONS AND GENERAL RELATIVITY. Klein, O. pp 23-6 of Preludes in Theoretical Physics. Amsterdam, North-Holland Publishing Co., 1966.

A discussion is presented on the boundary conditions of Einstein's gravitational field equations for the field outside of a spherically symmetric distribution of matter. An assumption is made that the system, as far as the gravitational field due to itself may be neglected, is surrounded by an infinite empty space of Lorentz metric. (B.G.D.)

26016 PARITY AND MOMENTUM. A PRELUDE TO THE USE OF GROUP THEORY IN PHYSICS. Lipkin, Harry J. (Weizmann Inst. of Science, Rehovoth, Israel). pp 27-34 of Preludes in Theoretical Physics. Amsterdam, North-Holland Publishing Co., 1966.

A discussion is presented, with regards to group theory, on parity and momentum, both of which do not commute with one another. It is shown that the hamiltonian of a physical system is invariant under two or more transformations which do not commute with one another. (B.G.D.)

26017 ARE WAVE FUNCTIONS FINITE? Low, F. E. (Massachusetts Inst. of Tech., Cambridge). pp 183-4 of Preludes in Theoretical Physics. Amsterdam, North-Holland Publishing Co., 1966.

A discussion is presented as to whether a principle exists in nature which requires that a wave function $\psi(r,t)$, which is finite (for all r) at some time t_0, remain finite for all t. (B.G.D.)

26018 AN ELEMENTARY NOTE ABOUT MIXTURES. D'Espagnat, B. (Univ., Paris). pp 185-91 of Preludes in Theoretical Physics. Amsterdam, North-Holland Publishing Co., 1966.

A discussion is presented on two exceptions of the word "mixture" in quantum theory which do not really describe the same kind of situation. (B.G.D.)

26019 ON SYMMETRY TRANSFORMATIONS. Wick, G. C. (Columbia Univ., New York. Brookhaven National Lab., Upton, N. Y.). pp 231-9 of Preludes in Theoretical Physics. Amsterdam, North-Holland Publishing Co., 1966. (BNL-9512).

A new proof is presented for Wigner's theorem which states that every transformation of the rays of Hilbert space, which preserves the inner product of rays, can be regarded as the result of either a unitary or an antiunitary transformation of the vectors of space. The relation of this theorem to certain facts familiar to physicists is also presented. A brief summary is given on the mapping of two-dimensional ray space on the Poincaré sphere is given. (B.G.D.)

26020 QUANTUM THEORY OF ELECTRIC CONDUCTIVITY. Thirring, W. (Univ., Vienna). pp 266-78 of Preludes in Theoretical Physics. Amsterdam, North-Holland Publishing Co., 1966.

Two models which are capable of a full mathematical treatment and can present relevant features of the quantum theory of electric conductivity are discussed. The phonon model, which provides the classical discussions of conductivity, is an electron bound to the origin by harmonic forces—to the electron coordinate q(t) and coupled to a vector field $\phi(x,t)$ at the origin. The impurity model, which shows the typical quantum aspects of conductivity, consists of an electron interaction with scattering centers which are in some way randomly distributed. (B.G.D.)

26021 THE MORAL ASPECT OF QUANTUM MECHANICS. Bell, J. S. (CERN, Geneva); Nauenberg, N. pp 279-86 of Preludes in Theoretical Physics. Amsterdam, North-Holland Publishing Co., 1966.

The morality of fundamental measurement processes in quantum mechanical systems is discussed. (B.G.D.)

Low Temperature Physics

Refer also to abstracts 25356 and 25771.

26022 (CALT-221-15) SUPERCONDUCTIVITY OF LaAg. Report No. 40. Chao, C. C.; Luo, H. L.; Smith, T. F. (California Inst. of Tech., Pasadena. W. M. Keck Lab. of Engineering Materials). Mar. 1966. Contract AT(04-3)-221. 10p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

The intermetallic compound LaAg was found to become superconducting at 0.9°K. The electric resistivity was measured by the standard four-wire method, using a Leeds and Northrup K-3 potentiometer from room temperature down to 4.2°K. Pressure effects on superconducting transition temperatures were investigated. The results are discussed. (M.O.W.)

26023 (JPL-TR-32-806) FORCE ON A SUPERCONDUCTING SPHERE IN A MAGNETIC FIELD: THE GENERAL CASE. Harding, John T. (Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena). Sept. 1, 1965. Contract NAS7-100. 13p.

Because a superconductor is diamagnetic, it experiences a force when immersed in a nonuniform magnetic field. The results of the calculation of the force acting on a sphere of zero permeability in an arbitrary magnetic field are given. The solution is obtained by expressing the applied field in a series of complete spherical harmonic functions, determining the induced field required to satisfy the boundary condition $B_{normal} = 0$, then integrating the Maxwell stress tensor over the sphere's surface. The final result appears as sums of products of the expansion coefficients of the applied field. To make the result more useful, it is also shown how to express the field due to an array of coils having concurrent axes in a series of spherical harmonics and, for the purpose of computing restoring forces, the applied field is expanded in a Taylor series expansion in the displacements. Two simple examples are shown. (auth)

26024 (N-65-35356) EXPERIMENTAL INVESTIGATION OF ADVANCED SUPERCONDUCTING MAGNETS. SUPERCONDUCTING STRIP AND ITS USE IN MAGNETS. Final Report. Hoag, Ethan (Avco-Everett Research Lab., Everett, Mass.). Sept. 1964. Contract NAS8-5279. 85p. (NASA-CR-67016). CFSTI $3.00 cy, $0.75 mn.

A theoretical and experimental program designed to develop a reliable contact that could be used in high-field

superconducting magnets, analyze the mechanism whereby current is transferred to a superconductor, establish design parameters that would permit comparative measurements on various types of joints, and establish a testing procedure for making such comparative measurements is reported. Presented are data on superconducting to normal and superconducting connections, anomalies in the anisotropy of wide superconducting strips, heat treatment and its effect on performance, magnetization and the current density profile of superconducting strip, and superconducting strip coil. (STAR)

26025 (N-65-35450) INVESTIGATION OF CURRENT DEGRADATION PHENOMENON IN SUPERCONDUCTING SOLENOIDS. Quarterly Progress Report No. 2, October 15, 1964-January 15, 1965. Salter, L. C. Jr. (Atomics International, Canoga Park, Calif.). Contract NAS8-5356. 30p. (NASA-CR-67190; AI-65-42). CFSTI $2.00 cy, $0.50 mn.

Measurements of critical current density versus transverse field, upper resistive critical field, normal-state-resistivity at 4.2°K, and room temperature resistivity, were completed on Nb-Ti wire samples. Well-defined maxima in critical current density and resistive upper critical field were found as a function of annealing temperature, and broader ranges of dependence were found for annealing times. Normal state resistivity measurements at 4.2°K and at room temperature were consistent with upper resistive critical field determinations. Quantitative correlations of variations in the upper resistive critical field are planned after the completion of critical temperature experiments. (STAR)

26026 (NYO-3029-9) HARD SUPERCONDUCTING MATERIALS. Annual Progress Report, 1965-1966. Silcox, J.; Webb, W. W. (Cornell Univ., Ithaca, N. Y. Dept. of Engineering Physics). Contract AT(30-1)-3029. 9p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

The experimental facilities at Cornell for investigating the behavior of large current carrying superconductors are briefly described. Brief summaries of investigations made on the following are presented: low frequency a-c response of superconductors, magnetization and critical currents of annealed and cold worked Type II alloys, tracing of individual fluxoids by quantum interference methods, pressure effects in superconductors, hysteresis observations using NMR field measurements, and magnetization mapping techniques. (M.O.W.)

26027 PARAMETRIC AMPLIFICATION WITH SUPERCONDUCTING FILMS. Bura, P. (RCA Labs., Princeton, N. J.). Appl. Phys. Lett., 8: 155-7(Apr. 1, 1966).

Large parametric gains were observed using a resonator consisting of superconducting films on mica substrates, inserted radially between the inner and outer conductor of a coaxial line. The superconducting films in the fin structure seriously distort the magnetic field in the line. The nonlinear variation of magnetization with the pump magnetic field is responsible for parametric amplification. (J.F.P.)

26028 EMPIRICAL STUDIES OF THE TEMPERATURE-DEPENDENT PROPERTIES OF SUPERCONDUCTORS. Borelius, G. (Royal Inst. of Tech., Stockholm). Ark. Fys., 31: 97-112(1966).

In a previous investigation on the temperature-dependent properties of superconductors a transition variable x was introduced, which for thermodynamic reasons is assumed to represent the fraction of valency electrons in the normal state increasing from 0 at 0°K to 1 at $T = T_c$. It is shown more extensively that x as a function of $t \equiv T/T_c$ is very different for different superconductors. It is also shown that the temperature-dependence of penetration depth, acoustical attenuation, and heat conductivity can be described phenomenologically and is a simpler and more general way by the use of x instead of t as the independent variable. The entropy of mixing is analyzed in detail as a function of x and a number n with different values for different superconductors. The new values obtained for n allow a more quantitative connection between the threshold values and the thermodynamic quantities characterizing the different superconductors. (L.B.S.)

26029 EFFECT OF HEAT TREATMENT ON SUPERCONDUCTING PROPERTIES OF COLD-WORKED NIOBIUM. Williams, I.; Catterall, J. A. (National Physical Lab., Teddington, Eng.). Brit. J. Appl. Phys., 17: 505-11(Apr. 1966).

Magnetization, critical currrent, and resistivity measurements were performed at 4.2°K on cold-swaged Nb wire annealed for two hours at different temperatures up to 1100°C and also on two samples heated at 2300°C. The areas under the magnetization curves, the critical current J_c, the critical field H_{c2}, the hardness, and the residual resistivity ρ_n all exhibit maximum values after annealing in the 500 to 700°C range. Measurements on etched wires suggest that the magnitude of the changes in these parameters depends on the interstitial content of the niobium. The results suggest also that a separation may be made between the factors which produce maximum flux pinning and those which produce maximum H_{c2}. A peak effect in J_c is exhibited by samples annealed at the higher temperatures, with the exception of the outgassed sample, and a linear relation exists between H_{c2} and ρ_n. (auth)

26030 STRUCTURE AND SUPERCONDUCTIVE PROPERTIES OF ELECTRODEPOSITED TIN FILMS. Hill, J. S. (National Physical Lab., Teddington, Eng.); MacLachlan, D. F. A.; Stoddart, C. T. H. Brit. J. Appl. Phys., 17: 513-20(Apr. 1966).

Thin films of tin were prepared by electrodepositon on germanium surfaces. The plating baths were based either on stannous sulfate or on potassium stannate. The surface structure of the films was examined using an electron microscope, and the superconductive properties of the films were studied. These properties bear little relation to the structure or plating conditions, but some correlation is found between the grain size of the films and the critical currents. (auth)

26031 SOME SUPERCONDUCTING PROPERTIES OF 25Nb-75Zr ALLOY. Ruzicka, J. (Nuclear Research Inst., Czechoslovak Academy of Sciences, Rez); Litomisky, M.; Malinsky, I. Czech. J. Phys., B16: 338-41(1966).

The manner of preparation of superconducting 25% wt Nb-75% wt Zr wires is described. Short samples of these wires were measured in static magnetic fields up to 80.5 kG, and the method of these measurements are described. The results of measuring the critical-current density dependence on the external perpendicular magnetic field for both cold-worked wires with different deformations and heat-treated wires. The dependence of the critical-current density on the heat-treatment temperature after wire deformation for different magnetic fields was obtained. The optimum heat-treatment temperature (vacuum better than 10^{-3} torr, 1 hour) is 450-600°C for magnetic fields 0-80.5 kG. The values of i_c of these wires in magnetic fields up to 60 kG are the same or higher than those of 75% Nb-25% Zr wires, and in fields above 60 kG they are much higher. (auth)

26032 INDUCTANCE OF A SUPERCONDUCTING SOLENOID. Sychev, V. V.; Zenkevich, V. B.; Andrianov, V. V. Dokl. Akad. Nauk SSSR, 165: 73-6(Nov. 1, 1965). (In Russian).

Earlier determinations of the inductance of superconducting solenoids led to contradictory results and transient processes in superconductive magnetic systems could not be explained by the existing ideas concerning the inductance of superconducting solenoids. Experiments are described using a test solenoid with 11,062 turns of Nb-33% Zr wire 0.2 mm in diameter. The first series of tests dealt with the solenoid carrying a weak a-c current component (1 ma, 80 cps) superimposed on a d-c current component. In the second set of tests, the solenoid carrying a prescribed d-c current was disconnected from the power supply by vacuum connectors and then connected across a discharge resistance (1 ohm). Computer calculations of the energy of the magnetic field within an appropriate magnetic field and the measured value of the total solenoid inductance at

liquid nitrogen temperatures yield a value of 0.971 H for the external inductance of the paramagnetic solenoid. This is in good agreement with the experimental results. A discussion is presented on the differences obtained in the two series of tests. (B.G.D.)

26033 MECHANISMS OF SUPERCONDUCTIVITY. Kresin, V. Z. (Moscow State Pedagogical Correspondence Inst.). Dokl. Akad. Nauk SSSR, 165: 1059-61(Dec. 11, 1965). (In Russian).

A possible mechanism for the superconductive state which is similar in many respects to the ordinary Frölich mechanism, but permits interaction between electrons in a wider energy region close to the Fermi surface is considered. Interelectron attraction in this model may be due to molecules in the crystal lattice. The molecule is polarized by the field of an electron with a transition to the excited oscillatory level. The molecular polarization causes a change in its electric field which affects the state of another electron. The energy of this electron is changed by a return of the molecule to the ground state. The interaction between electrons may be imagined as an exhange of virtual quanta which describe the excitation of oscillatory molecular levels. This mechanism is completely analogous to the ordinary mechanism with the difference that in this case the part of oscillatory molecular levels. The distinguishing features of the proposed model are discussed. An experiment is proposed for verification of this model which requires a heavily doped metal or semiconductor. It is possible that the proposed conditions for the experiment could be met by joint condensation of vapors which contain molecules of the base material and the dopant. In this way a crystal could be produced with ordered distribution of the dopant molecules. Superconductivity is possible in presently known molecular crystals with high electrical conductivity due to the overlapping of the orbits of π-electrons. In this case the superconductivity would be the result of the interaction between conduction electrons and the oscillatory levels of the molecules which make up the crystal. (ATD)

26034 MAXIMUM CRITICAL MAGNETIC FIELDS IN SUPERCONDUCTING METALS. Lazarev, B. G.; Semenenko, E. E.; Sudovtsov, A. I.; Kuz'menko, V. M. (Physico-technical Inst., Academy of Sciences, Ukrainian SSR). Dokl. Akad. Nauk SSSR, 165: 1275-7(Dec. 21, 1965). (In Russian).

Lattice distortions are used as a criterion for measuring the critical magnetic fields and temperatures in indium, tin, and thallium specimens produced by condensation on a glass substrate cooled by liquid helium. The critical magnetic field in the longitudinal direction was determined from the normal electrical resistance of the specimens at this field intensity. The highest critical magnetic fields are observed in freshly precipitated specimens, where the lattice is most strongly distorted. The critical magnetic fields in well annealed specimens are close to that of a conventional single crystal specimen. It was found that the maximum magnetic fields are independent of the thickness of the specimen. When the resistivity is high, the curves for critical magnetic field strength as a function of resistivity in indium are identical in form, showing saturation at a resistivity of $(5-6)\cdot 10^{-6}\ \Omega\cdot$cm (which corresponds to the mean free path of electrons, i.e., about 100 interatomic distances). Similar behavior was observed for the maximum critical field in tin. The critical field increases linearly in thallium and shows no tendency to saturation. The data indicate that a metal formed by condensation on an extremely cold substrate displays maximum distortion of the crystal lattice. Therefore the magnetic fields of $(20-25)\cdot 10^3$ oersteds for indium and $(40-45)\cdot 10^3$ oersteds for tin are the maximum fields for these metals. (ATD)

26035 MAGNETIC SHIELDING BY SUPERCONDUCTING NIOBIUM TIN PLATES. Benaroya, R.; Mogensen, H. P. (Argonne National Lab., Ill.). J. Appl. Phys., 37: 2162-6(Apr. 1966).

The effectiveness of magnetic shielding between superconducting Nb_3Sn plates at 4.2°K in transverse magnetic fields up to 19.6 kG was studied. At 19.6 kG the field exclusion obtained in the center between two $3.0\times 2.5\times 0.3$-cm thick plates, separated from each other by 1.0 cm, was 17.9 kG. It was found that flux jumps not only degrade the shielding capability of the plates but also give rise to nonsymmetrical field distributions. A relation was established between the applied field B_1 and its critical rate of increase $(dB_1/dt)_c$, below which flux jumps do not occur for pairs of plates of various thickness. Flux jumps were completely eliminated by keeping $dB_1/dt < (dB_1/dt)_c$. Bean's model of current penetration into a high-field superconductor and the assumption of induced rectangular current loops were successfully applied in calculating field distributions between the plates at medium and high applied fields. This model is not as successful at the early stages of plate magnetization where the current penetration is a small fraction of the total depth of the superconductor and the surface currents are appreciable. It was found that the condition of field reversal external to the shielding volume can be minimized by the use of shunt iron in close proximity to the superconducting plates. Such a feature is desirable for the application of superconductor plate shields to a deflector system for a high-intensity variable-energy cyclotron. (auth)

26036 TEMPERATURE VARIATION OF THE GINZBURG-LANDAU PARAMETER IN NIOBIUM SINGLE CRYSTALS. Skinner II, L. C.; Rose, R. M.; Wulff, J. (Massachusetts Inst. of Tech., Cambridge). J. Appl. Phys., 37: 2191-2(Apr. 1966).

Three single-crystal specimens of niobium were prepared by the electron-beam floating-zone technique, and magnetization curves were made at temperatures from 1.61 to 8.78°K. The values of H_{c2} and $(dM/dH)_{H_{c2}}$ were measured directly from the magnetization curves from which the parameters k_1 and k_2 were determined. The temperature dependence of k_1 and k_2 are plotted together with theoretical curves of the Ginzburg-Landau and Abrikosov model. It is concluded that the Abrikosov model is useful at temperatures as low as 0.2 T_c in "clean" type-II superconductors if the parameters k_1 and k_2 associated with H_{c2} and $(dM/dH)_{H_{c2}}$ are considered as being distinct. (L.B.S.)

26037 MOTION OF VORTEX FILAMENTS IN SUPERCONDUCTING ALLOYS. Galaiko, V. P. (Kharkov State Univ.). JETP Lett. (USSR)(Engl. Transl.), 3: 76-8(Feb. 1, 1966).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Redakt., 3: 121-5(Feb. 1, 1966).

An equation for the motion of vortex filaments in superconducting alloys is derived. (D.C.W.)

26038 PHASE TRANSITION IN SUPERCONDUCTORS OF SMALL SIZE. Shmidt, V. V. (Baikov Metallurgy Inst., USSR). JETP Lett. (USSR)(Engl. Transl.), 3: 89-91 (Feb. 1, 1966).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Redakt., 3: 141-5(Feb. 1, 1966).

It is shown that large fluctuations in the ordering parameter, which lead to the smearing of the second-order phase transition over a certain temperature interval, may be appreciable for superconducting particles that are small in comparison to the dimension of the Cooper pair. (G.O.Y.)

26039 USE OF SUBSTANCES CONTAINING RARE-EARTH IONS WITH EVEN NUMBER OF ELECTRONS TO OBTAIN ULTRALOW TEMPERATURES. Al'tshuler, S. A. (Kazan State Univ.). JETP Lett. (USSR)(Engl. Transl.), 3: 112-14(Feb. 15, 1966).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Redakt., 3: 177-80(Feb. 15, 1966).

The possibility of using rare-earth ions with an even number of electrons in magnetic cooling is briefly discussed. It is also noted that a trace of such ions may be advantageously used to reduce the relaxation time in salts that are commonly used for magnetic cooling. (D.C.W.)

26040 NONSTATIONARY PHENOMENA IN THE MIXED STATE OF SUPERCONDUCTORS OF THE SECOND KIND. Kulik, I. O. (Physico-Technical Inst. of Low Tempera-

tures, Academy of Sciences, Ukrainian SSR). JETP Lett. (USSR)(Engl. Transl.), 3: 116-18(Feb. 15, 1966).
Translated from Zh. Eksp. Teor. Fiz., Pis'ma Redakt., 3: 183-6(Feb. 15, 1966).

The phenomena accompanying the motion of quantized magnetic flux lines in the presence of an electric field are studied. (D.C.W.)

26041 SUPERCONDUCTIVITY OF La_3Te_4. Zhuze, V. P.; Shalyt, S. S.; Noskin, V. A.; Sergeeva, V. M. (Inst. of Semiconductors, Academy of Sciences, USSR). JETP Lett. (USSR) (Engl. Transl.), 3: 138-9(Mar. 1, 1966).
Translated from Zh. Eksp. Teor. Fiz., Pis'ma Redakt., 3: 217-19(Mar. 1, 1966).

It is shown that La_3Te_4, a chalcogenide, is a superconductor of the second kind, and that the superconducting-transition temperature depends on the technology of its preparation and may be connected with some deviation of the composition from stoichiometry. The temperature dependence of the resistivity, the resistivity versus the transverse magnetic field intensity at 1.4°K, and the magnitude of the magnetic moment relative to lead versus the longitudinal magnetic field intensity at 1.4°K are shown for this compound. (J.F.P.)

26042 BOSE SYSTEM WITH LENNARD-JONES INTERACTION. Liu, L. (Northwestern Univ., Evanston, Ill.). Nuovo Cimento (10), 43B: 36-41(May 11, 1966).

The first few terms in a density expansion of the ground-state energy and the excitation spectrum for a system of Bose particles interacting with Lennard-Jones potential $\epsilon[(\sigma/r)^n - (\sigma/r)^m]$ are calculated. Because of calculation difficulties only the cases with $m \geq 4$ and $n = 2(m-1)$ are considered. (auth)

26043 MAGNETIC HYSTERESIS AND ALTERNATING CURRENT LOSS OF HIGH-FIELD SUPERCONDUCTORS. Heinzel, W. (Siemens-Schuckertwerke AG, Erlangen, Ger.). Phys. Lett., 20: 260-2(Feb. 15, 1966). (In German).

The magnetization at small field changes was investigated on Nb–^{25}Zr. Hysteresis loops of the magnetization were found whose energy content agrees in the order of size with the hysteresis occurring with a-c currents. (tr-auth)

26044 MAGNETIC HYSTERESIS LOSS OF HIGH-FIELD SUPERCONDUCTORS. Voigt, H. (Siemens-Schuckertwerke AG, Erlangen, Ger.). Phys. Lett., 20: 262-3 (Feb. 15, 1966). (In German).

The magnetic hysteresis losses of high-field superconductors were calculated for the case in which the critical current density is a random function of the magnetic field. Measurements of the hysteresis losses of Nb–^{25}Zr leads to the same critical current density as was obtained from the critical transport current. (tr-auth)

26045 ULTRASONIC ATTENUATION IN THE MIXED STATE OF SUPERCONDUCTING NIOBIUM. Forgan, E. M.; Gough, C. E. (Univ. of Birmingham, Eng.). Phys. Lett., 21: 133-5(May 1, 1966).

Measurements of the ultrasonic attenuation in the mixed state of superconducting niobium are presented, and are discussed in terms of theoretical models for the flux lines and their interaction with thermally excited electrons. (auth)

26046 ON THE SPECIFIC HEAT OF TYPE II SUPERCONDUCTORS IN THE MIXED STATE. Van Vijfeijken, A. G. (Philips' Gloeilampenfabrieken, Eindhoven, Netherlands). Phys. Lett., 21: 140-1(May 1, 1966).

A calculation is given of the specific heat of superconductors in the mixed state. The jump at the transition to the normal state is also calculated. The results agree fairly well with recent experiments. (auth)

26047 INVESTIGATION OF THE λ POINT OF ^{3}He–^{4}He MIXTURES BY NMR. Beal, B. T.; Hatton, J.; Harrison, R. B. (Oxford Univ.). Phys. Lett., 21: 142-4 (May 1, 1966).

The λ-transition temperature of liquid mixtures of ^{3}He–^{4}He under pressure were investigated using a NMR technique by observing the discontinuous change in the spin-lattice relaxation time of the ^{3}He nuclei at T_λ of the mixture. (auth)

26048 EVIDENCE OF SURFACE CURRENTS IN THE MIXED STATE OF NON-IDEAL TYPE II SUPERCONDUCTORS. Leblanc, M. A. R.; Griffiths, D. J. (Univ. of Southern California, Los Angeles). Phys. Lett., 21: 150-2(May 1, 1966).

Evidence for the existence of a surface sheath in the mixed state of non-ideal type II superconductors is presented. Further, it is deduced that a macroscopic paramagnetic current arises in this surface sheath upon cooling from T_c in the presence of a stationary longitudinal magnetic field. (auth)

26049 NUCLEAR MAGNETIC RESONANCE AND RELAXATION IN SOLID HYDROGEN. Harris, A. Brooks (Univ. of Pennsylvania, Philadelphia); Hunt, Earle. Phys. Rev. Lett., 16: 845-8(May 9, 1966).

An interpretation of NMR data is presented for solid hydrogen at normal pressure and ortho concentration at temperatures between transition (1.6°K) and 4.2°K. Conclusions show that the correlation time associated with molecular rotation is much shorter than previously estimated from measurements of the spin-lattice relaxation time, a rotational correlation time is to be expected from the intermolecular interactions of the molecular quadrupole moments, and from NMR linewidth data, the magnitude of the crystal-field splittings for the J = 1 rotational manifold are deduced to be 0.22 and 0.024 cm^{-1} for normal H_2 and D_2, respectively. (B.G.D.)

26050 FROZEN-IN FLUX IN A MULTIPLY CONNECTED SUPERCONDUCTIVE NETWORK. De Bruyn Ouboter, R.; Arnold, A. J. P. T.; Van Beelen, H.; Taconis, K. W. (Kamerlingh Onnes Laboratorium, Leiden). Physica, 31: 1728-34(Dec. 1965).

In a multiply connected superconductive network, containing 4.17 million cells on 1 cm^2, the total frozen-in flux is measured, which rises continuously as a function of the original applied magnetic field, indicating no quantization of the total frozen-in flux. A suggestion made by Parks, which possibly explains these results, is discussed and extended. (auth)

26051 METHOD OF PLOTTING FIELD AND CURRENT-INDUCED PHASE TRANSITION IN SUPERCONDUCTORS. Kolb, Werner (Siemens and Halske AG, Munich). Rev. Sci. Instrum., 37: 567-8(May 1966).

A method is outlined to plot the dependence of the critical field of a superconductor on its critical current automatically on the screen of an oscilloscope. Critical field and current, respectively, control the X and Y input of the oscilloscope whereas the beam intensity is controlled by the voltage drop across the superconductor. Use of short current and field pulses eliminates disturbing thermal effects. The device is particularly useful for routine measurements on cryotron circuits. (auth)

26052 POSSIBILITY OF EXISTENCE OF SUPERCONDUCTIVITY IN FERROMAGNETIC MATERIALS HAVING A DOMAIN STRUCTURE. Kopaev, Yu. V. Soviet Phys.-Solid State (Engl. Transl.), 7: 2360-3(Apr. 1966).
Translated from Fiz. Tverd. Tela, 7: 2907-11(Oct. 1965).

The conditions of the existence of superconductivity are examined along the domain boundaries in ferromagnetic materials having a domain structure for two cases. These are when the possible superconductivity is induced by nonmagnetic s-electrons and when only magnetic electrons are present. In the first case, the magnetizing action of inner electrons on the outer electrons is weakened along the domain boundaries either because of the small magnetization moment, the moment varying along the transition layer, or because of the possible penetration of the magnetic field in the presence of rotational moment. In the second case, the superconductivity is due to the possible formation of electron pairs of opposite spins from neighboring domains along the boundary between them. (auth)

26053 SUPERCONDUCTIVITY. Kakushadze, T. I. Tr. Tblissk. Gos. Ped. Inst., 18: 177-92(1964).

In view of the difficulties arising in modern superconductivity theory in connection with the explanation of sound-wave absorption by superconductors, a new theory of superconductivity is proposed. In accordance with experimental data a crystal is thought of as a set of ideally ordered blocks isolated from each other by intermediate structureless layers. The critical temperature is defined as the temperature at which the vibration of the blocks ceases. In view of the absence of scattering, the metal assumes a superconducting state. Proceeding from these concepts, some qualitative ideas to explain the Meissner effect, the isotopic effect, the penetration depth, the effect of mechanical treatment, and the absorption of acoustic and optical waves are presented. It is postulated that the new theory completely encompasses various properties of the solid state, including superconductivity. (CFSTI)

26054 ON THE ESTABLISHMENT OF CONCENTRATION EQUILIBRIUM IN CRYSTALLIZATION OF HELIUM ISOTOPE SOLUTIONS. Bogayavlenskii, I. V.; Bereznyak, N. G. (Inst. of Physics and Tech., Khar'kov). Ukr. Fiz. Zh., 10: 1376-7(Dec. 1965). (In Ukrainian).

Special experiments were set up to attain conditions where a diffusion mechanism would assure the equilibrium concentration of ^{3}He in ^{4}He solutions. The maximum size of the solid-phase particles was controlled at ~10 microns by crystallizing in a porous block sintered from copper powder. The diffusion equilibrium time was estimated from the relaxation $\chi^2 = Dt_0$. Here D was the self-diffusion coefficient of ^{3}He with a value of 3×10^{-7} cm^2/sec. The value of t_0 was estimated to be <3 sec. A 76.5% ^{3}He solution was crystallized at 1.3 to 4.2°K, and the equilibrium values of ΔT and ΔP were determined over a period of 10 hours with accuracies of ±0.004°K and ±0.3 atm. respectively. An analysis of these results showed that equilibrium had been attained in a previous study of the ^{3}He–^{4}He system. (TTT)

26055 EFFECT OF IMPURITIES ON THE DEPENDENCE OF THE SUPERCONDUCTING TRANSITION TEMPERATURE OF THALLIUM ON PRESSURE. Lazarev, B. G.; Lazareva, L. S.; Makarov, V. M.; Tereshina, N. S. (Inst. of Physics and Tech., Kiev). Zh. Eksp. Teor. Fiz., 50: 546-50(Mar. 1966). (In Russian).

The effect of an admixture of indium on the dependence of the superconducting transition temperature of thallium on pressure is investigated. It is found that the effect of indium (which has the same valency as thallium) on the $T_k(p)$ dependence of thallium is similar to that of antimony and bismuth (the valency of which is greater than that of thallium). For thallium alloys containing 3.57 and 7.15 at.% of indium the dependence $T_k(p)$ is linear, the values of dT_k/dp being $-1.2 \cdot 10^{-5}$ and $-1.6 \cdot 10^{-5}$ degree/atm respectively; these values are close to that for pure thallium ($dT_k/dp = 1.4 \cdot 10^{-5}$) at pressures from 20,000 to 28,000 atm. The experimental data obtained confirm the opinion previously expressed regarding the sensitivity of the electron spectrum of thallium to impurities and pressure. (auth)

26056 SUPERCONDUCTING MODEL WITH AN EXACT SOLUTION. Minlos, R. A. (Moscow State Univ.). Zh. Eksp. Teor. Fiz., 50: 642-52(Mar. 1966). (In Russian).

A system resembling the BCS superconductivity model is considered. The energy levels as well as the ground state energy can be determined exactly. Variation of the ground state with variation of density can be studied. It is found that the system can be separated into two noninteracting parts (phases) and at small densities (for certain values of the interaction parameter) only one phase is present in the ground state. A gap in the excitation spectrum is encountered in a certain density range; the nature of this gap is however different from that in the BCS model. The statistical sum of the system can be calculated. (auth)

26057 STABILITY LIMITS OF THE SUPERCONDUCTING STATE IN A MAGNETIC FIELD FOR SUPERCONDUCTORS OF THE SECOND KIND. Galaiko, V. P. (Khar'kov State Univ.). Zh. Eksp. Teor. Fiz., 50: 717-23(Mar. 1966). (In Russian).

The Gibbs free energy function $\Omega\{\Delta\}$ for a superconductor in a magnetic field is treated on basis of the BCS theory as a functional of the superconducting ordering parameter. This extends the corresponding expression of the Ginzburg–Landau theory to arbitrary temperatures. The free energy is minimum at equilibrium. This yields the equilibrium electrodynamic equations which in the case of superconductors of the second kind describe the usual superconducting state with finite penetration of the field as well as the mixed Abrikosov state with vortex lines which permeate the massive superconductor. The second variation of the free energy is investigated in the vicinity of the superconducting state and it is shown that the state is stable with respect to small fluctuations of the ordering parameter up to a certain critical field $H'_{c1} > H_{c1}$, for which $\delta^2\Omega$ changes sign for the first time. The field strength $H'_{c1}(T)$ is calculated for extremely hard superconductors ($\varkappa \gg 1$). (auth)

26058 ON THE POSSIBILITY OF PHENOMENA SIMILAR TO SUPERCONDUCTIVITY IN A ONE-DIMENSIONAL SYSTEM. Bychkov, Yu. A.; Gor'kov, L. P.; Dzyaloshinskii, I. E. (Inst. of Theoretical Physics, Academy of Sciences, USSR). Zh. Eksp. Teor. Fiz., 50: 738-58(Mar. 1966). (In Russian).

The Fermi state in a one-dimensional system is shown to be unstable relative to an arbitrarily weak attraction between the particles. In distinction to the three-dimensional case, it is not pairs that are specific but particle quartets near the Fermi surface. Instability changes the ground state in such a way that a spectrum gap appears and the structure period doubles. However the new ground state is capable of passing a current without dissipation of energy. Interaction with the lattice is taken into account; its role is that it leads to the appearance of an effective interaction between the electrons. If the effective interaction turns out to be repulsive (but weak) the system remains in the metallic state at all temperatures. The fluctuation problems are discussed. (auth)

26059 SPECIFIC HEAT OF THIN SUPERCONDUCTING FILMS IN A MAGNETIC FIELD. Ovchinnikov, Yu. N. (Moscow Inst. of Physics and Tech.). Zh. Eksp. Teor. Fiz., 50: 795-8(Mar. 1966). (In Russian).

The behavior of a thin superconducting film in a stationary magnetic field is considered. The field is assumed to be directed along the film and to satisfy the condition $(\xi_0 d)^{-1} \ll eH \ll d^{-2}$ where d is the film thickness and $\xi_0 = v/T_c$ is the correlation parameter. On this condition the ordering parameter $\Delta(r)$ can be considered to be the same throughout the film. However even such fields appreciably change the spectrum. It is shown that the quantity does not any longer play the role of a gap in the spectrum. The gap depends on the angles and for certain directions it vanishes. The spectrum derived is used for determining the thermal capacity of the film. It is shown that at low temperatures ($T \ll T_c$) the specific heat decreases according to a power law. (auth)

26060 JOSEPHSON TUNNEL EFFECT IN SUPERCONDUCTORS WITH PARAMAGNETIC ADMIXTURES. Kulik, I. O. (Inst. of Physics and Tech. of Low Temperatures, Academy of Sciences, Ukrainian SSR). Zh. Eksp. Teor. Fiz., 50: 799-806(Mar. 1966). (In Russian).

A theory of the Josephson effect in superconductors with paramagnetic admixtures is developed for T = 0 and the absence of a potential difference between the superconductors. It is shown that the superconducting tunnel current differs from zero in the region of ordinary ($\omega_g \neq 0$) as well as gaples ($\omega_g = 0$) superconductivity and the dependence of the peak value of the current on concentration of the paramagnetic impurities is found. Nonmagnetic impurities which do not affect the electron spin direction during scattering also do not affect the magnitude of the stationary Josephson current. (auth)

Neutron Physics

See also REACTOR TECHNOLOGY — Criticality Studies

26061 (CEA-R-2896) JANVIER: PROGRAMME DE RESOLUTION SUR IBM 7094 DES PROBLEMES DE CELLULES EN GEOMETRIE PLANE, SPHERIQUE ET CYLINDRIQUE DANS L'APPROXIMATION DOUBLE P_n. (January: IBM 7094 Program for the Resolution of Cell Problems in Planar, Spherical, and Cylindrical Geometry Using the Double P_n Approximation). Amouyal, Albert; Tariel, Henri (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Feb. 1966. 17p. Dep. Mn.

A FORTRAN II program was written for resolving cell problems with one space variable and with one energy group, with isotopic sources in the double P_n approximation. The differential equations with limiting conditions were transformed into differential system with initial conditions which are integrated by a separate-step method. (M.O.W.)

26062 (CEA-R-2971) SUR LA SOLUTION DE QUELQUES PROBLEMS DE DIFFUSIONS MULTIPLES PAR LA METHODE DE MONTE-CARLO. (On the Solution of a Few Problems of Multiple Scattering by Monte Carlo Method). Bluet, Jean-Claude (Commissariat a l'Energie Atomique, Cadarache (France). Centre d'Etudes Nucleaires). Feb. 1966. 55p. Dep. mn.

Three problems of multiple scattering arising from neutron cross sections experiments, are reported. The common hypotheses are: elastic scattering is the only possible process, angular distributions are isotropic, and losses of particle energy are negligible in successive collisions. In the three cases practical results, corresponding to actual experiments are given. Moreover the results are shown in more general ways, using dimensionless variable such as the ratio of geometrical dimensions to neutron mean free path. The FORTRAN codes are given together with the corresponding flow charts, and lexicons of symbols. The three problems are as listed: (1) Measurement of sodium capture cross section. A sodium sample of given geometry is submitted to a neutron flux. Induced activity is then measured by means of a sodium iodide crystal. The distribution of active nuclei in the sample, and the counter efficiency are calculated by Monte Carlo method taking multiple scattering into account. (2) Absolute measurement of a neutron flux using a glass scintillator. The scintillator is made of lithium-6 loaded glass, and was submitted to neutron flux perpendicular to its plane faces. If the glass thickness e is not negligible compared with scattering mean free path λ, the mean path e′ of neutrons in the glass is different from the thickness. Monte Carlo calculations are made to compute this path and a relative correction to efficiency equal to $e' - e/e$. (3) Study of a neutron collimator. A neutron detector is placed at the bottom of a cylinder surrounded with water. A neutron source is placed on the cylinder axis, in front of the water shield. The number of neutron tracks going directly and indirectly through the water from the source to the detector are counted. (auth)

26063 (CEX-65.01) FEASIBILITY STUDY: INTENSE 14-Mev NEUTRON SOURCE FOR OPERATION HENRE. Provenzano, T. G.; Story, E. J.; Haywood, F. F.; Miller, H. T. (Oak Ridge National Lab., Tenn.). Sept. 1965. Contract W-7405-eng-26. 65p. Dep. mn. CFSTI $1.00 cy, $0.75 mn.

The design and fabrication of a high-intensity, 14-Mev neutron source which can be operated on a hoist platform on the 1500-ft BREN tower at the Nevada Test Site (NTS) was determined to be feasible. Utilizing the $T(d,n)^4He$ reaction, the source should be capable of producing, as a minimum, an average intensity of 10^{13} neutrons/sec for periods up to 4 hr. The type and placement of power supplies, ion sources, targets, and vacuum equipment were examined and a preliminary conceptual design completed. Control systems, testing procedures, and construction operations were studied and are presented. It is estimated that the neutron source will cost from $260,000 to $300,000, occupy approximately 400 ft^3, weigh approximately 7.5 tons and require about 10 months to complete. (auth)

26064 (IFA-FR-48) NEUTRON TRANSPORT THEORY. Bibliography. Rosescu, Teodor (comp.) (Institutul de Fizica Atomica, Academia R. P. R., Bucharest (Romania)). 1965. 135p. Dep. mn.

Included is a list of 1200 references covering the period 1930–Aug. 1965 on neutron transport theory. (M.O.W.)

26065 (NDA-42) SOME RECENT CALCULATIONS ON THE PENETRATION OF FISSION NEUTRONS IN LiH. Goldstein, Herbert (Nuclear Development Corp. of America, White Plains, N. Y.). Aug. 7, 1957. Contract AT (30-3)-256. 16p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Fast neutron penetration from a point isotropic fission source in an infinite medium of LiH was recalculated by the moments method using recently measured values of the nonelastic cross section as the absorption cross section. The newly computed doses fall faster than the previous theoretical values up to penetrations of about 60 gm/cm^2. At this distance, the dose found here is about one-half of that predicted earlier. For larger penetrations, the new calculations decrease less rapidly than the old results, and the two dose curves cross about 105 gm/cm^2. Up to 60 gm/cm^2, the relaxation length for the dose curve is closely 5.44 gm/cm^2; from 60 gm/cm^2 to 120 gm/cm^2, it is 7.60 gm/cm^2. From the slope of the dose curve up to 70 gm/cm^2 a removal cross section for Li of 1.07b can be deduced, which is only .06b larger than the experimental value, but the magnitude of the dose, up to 90 gm/cm^2, is better given by a Li removal cross section of 0.88b. Number spectra were also calculated and show the expected "hardening" with distance. The calculations could be further improved by taking into account secondary neutrons and by including revisions in the elastic scattering angular distributions. (auth)

26066 (AECL-2330, pp 251-4) TEMPERATURE DEPENDENCE OF THE SQUARE OF THE DIFFUSION LENGTH AND THE DIFFUSION COEFFICIENT OF THERMAL NEUTRONS FOR A NUMBER OF ORGANIC COMPOUNDS. Yurova, L. N.; Stepanov, S. B.; Alimov, G. A. Translated from pp 208-10 of Issledovaniya po Primeneniyu Organicheskikh Teplonositelei-Zamedlitelei v Energeticheskikh Reaktorakh, Atomizdat, Moscow, 1964.

The temperature dependence of the square of the length of diffusion and the coefficient of diffusion of thermal neutrons was investigated for 8 different organic compounds used as heat transfer agents. The impulse source method was used to determine the decay constant, and the temperature was varied from 14 to 248°C. Tabulated results are presented for benzene, biphenyl, benzylbenzene, diphenyl oxide, gas-oil, monoisopropylbiphenyl, anisole, and tetradecane. (ATD)

26067 MEASUREMENT OF THE NEUTRON SLOWING-DOWN TIME DISTRIBUTION AT 1.46 ev AND ITS SPACE DEPENDENCE IN WATER. Moeller, E. (Aktiebolaget Atomenergi, Studsvik, Sweden). Ark. Fys., 31: 255-70 (1966).

The use of the time dependent reaction rate method for the measurement of neutron slowing-down time distributions in hydrogen was analyzed and applied to the case of slowing down in water. Neutrons with energies of about 1 Mev were slowed down, and the time-dependent neutron density at 1.46 ev and its space dependence was measured with a time resolution of 0.042 μs. The results confirm the well-known theory for time-dependent slowing down in hydrogen. The space dependence of the distributions is well described by the P_1-calculations by Claesson. (auth)

26068 MEASUREMENT OF TIME DEPENDENCE OF NEUTRON SLOWING DOWN AND THERMALIZATION IN HEAVY WATER. Moeller, E. (Aktiebolaget Atomenergi, Studsvik, Sweden). Ark. Fys., 31: 335-53(1966).

The behavior of neutrons during their slowing down and

thermalization in heavy water was followed on the time scale by measurements of the time-dependent rate of reaction between the flux and the three spectrum indicators indium, cadmium and gadolinium. The space dependence of the reaction rate curves was also studied. The time-dependent density at 1.46 ev is well reproduced by a function, given by von Dardel, and a time for the maximum density of 7.1 ± 0.3 μs was obtained for this energy in deuterium gas in agreement with the theoretical value of 7.2 μs. The spatial variation of this time is in accord with the calculations by Claesson. The slowing-down time to 0.2 ev was found to be 16.3 ± 2.4 μs. The approach to the equilibrium spectrum takes place with a time constant of 33 ± 4 μs, and the equilibrium was established after about 200 μs. Comparison of the measured curves for cadmium and gadolinium with multigroup calculations of the time-dependent flux and reaction rate show the superiority of the scattering models for heavy water of Butler and of Brown and St. John over the mass 2 gas model. The experiment was supplemented with Monte Carlo calculations of the slowing-down time. (auth)

26069 THE AGE OF ^{124}Sb–Be NEUTRONS IN GRAPHITE. Haider, N.; Grant, P. J. (Imperial Coll. of Science and Tech., London). Brit. J. Appl. Phys., 17: 531-4(Apr. 1966).

The spatial distribution in graphite of indium resonance (1.46-ev) neutrons from a ^{124}Sb–Be photoneutron source was determined by measuring the change in the counting rate of a cadmium-covered neutron-sensitive scintillation counter when it was covered by indium foil. The age was found to be 151 ± 2 cm^2, normalized to a graphite density of 1.60 g cm^{-3}. (auth)

26070 CALCULATION METHOD OF RESONANCE ABSORPTION IN INFINITE HOMOGENEOUS MIXTURES. Vertes, Peter (Central Research Inst. for Physics, Budapest). Nukleonika, 8: 140-6(Mar. 1966).

An exact solution of the Weinberg-Wigner-Corngold equation and its application to the calculation of resonance escape probability are discussed. The method was applied to several special cases, and the corrections coming from resonance self-shielding were examined. By the method described, it was possible to investigate the interference from neighboring resonances due to the collision density. (auth)

26071 MATHEMATICAL FOUNDATIONS OF KINETICS IN NEUTRON TRANSPORT THEORY. Marti, J. T. (Therm-Atom AG, Winterthur, Ger.). Nukleonika, 8: 159-63(Mar. 1966).

It is shown that the fundamental equations of kinetics in neutron transport theory form an initial and boundary value problem, which, as abstract Cauchy problem in a suitably chosen Banach space, has a unique strongly continuous and strongly continuously differentiable solution that preserves positiveness. The proof is based on the theory of semigroups of bounded linear operators in a Banach space whose perturbation theory gives an explicit representation of the solution. The investigation of the adjoint problem gives a mathematical definition of the concept of time-dependent importance, which, until now, was derived from physical considerations only. (auth)

26072 SOLUTION OF THE LINEAR TRANSPORT EQUATION BY FINITE FOURIER TRANSFORMS. Bhattacharjie, A. (Northrop Corp., Hawthorne, Calif.). Nuovo Cimento (10), 43B: 6-35(May 11, 1966).

A new method to solve the energy-independent transport equation in a bare slab by finite Fourier transforms is developed. For thin slabs or slabs of moderate thickness the neutron scalar flux and the transmission, reflection, and absorption coefficients are shown to have simple forms not previously known. The method is essentially simpler than existing solutions for the slab problem for obtaining numerical answers or approximate analytical solutions. While solutions for isotropic and anisotropic scattering with a particular scattering function are given, the method is well suited for a general type of scattering function. (auth)

26073 MULTIPLE SCATTERING OF NEUTRONS AND CORRELATION FUNCTIONS. Sunakawa, Sigenobu; Fukui, Yoshihiko; Nishigori, Takeo (Tohoku Univ., Sendai). Progr. Theoret. Phys. (Kyoto), 35: 228-40(Feb. 1966).

The Van Hove formula for neutron scattering is generalized to include multiple scattering. The differential cross section is written in terms of the many-particle space-time correlation functions for the target system. As a simple example, a heavy gas system is treated, and the behavior of the multiple elastic scattering is discussed for the cases of the low- and high-energy limits of the incident neutron energy. (auth)

26074 ON THE SOLUTION OF THE NEUTRON TRANSPORT EQUATION IN P_3 APPROXIMATION. Mennig, Johannes (Eidgenoessische Institut fuer Reaktorforschung, Wuerenlingen, Switzerland); Tschirky, Hugo. Z. Angew. Math. Phys., 17: 334-7(1966). (In German).

The solution of the multigroup P_3-equations by Bessel-functions leads to difficulties as the number of particular integrals is gradually increasing. The central zone of a cylindrically symmetric problem is treated in the P_3-approximation using Taylor-series. The recursive relations are developed in order to calculate numerically the coefficients of the series. (auth)

26075 WAVE MECHANICAL CALCULATION OF THE SCATTERING OF NEUTRONS ON MAGNETIC CRYSTALS. Doering, Werner (Univ., Hamburg). Z. Angew. Phys., 20: 311-17(Apr. 1966). (In German).

The scattering of neutrons by magnetized crystals is calculated using the assumption that the induction of the scatterer is a given function of time and place. This assumption is really not correct for the inelastic scattering, but this causes only a somewhat incorrect factor in the formula for the absolute value of the intensity of the scattered wave in the case of emission of magnons, which is practically unimportant. On the other hand it has the advantage that the calculation is possible without any assumption for the hamiltonian of the magnetized substance. The elastic scattering depends only on the time-mean value of the induction. The oscillations of the magnetization vector produce inelastic scattering. The formulas for the intensity of the scattering wave as a function of the direction of the magnetization and of the polarization vector of the incoming neutrons is calculated in a simple way without using the Heisenberg model. It is shown that the dependency of the intensity of the inelastic scattering wave on the direction of the neutron spin has nothing to do with the interaction of the magnetic moments of the scatterer, but only with the precession movement of the electron spins and the sign of this rotation. These calculations are generalized for a precession movement on an elliptical cone. (auth)

26076 ELASTIC AND QUASIELASTIC SCATTERING OF NEUTRONS BY MOLECULES. Ivanov, G. K. (Inst. of Chemical Physics, Academy of Sciences, USSR). Zh. Eksp. Teor. Fiz., 50: 726-37(Mar. 1966). (In Russian).

Neutron scattering cross sections of molecules are calculated for the case when the imparted energy is of the order of the mean difference between the rotational energy levels of the molecule and much smaller than the mean thermal excitation energy of the molecule. The quasiclassical representation of rotational wave functions are employed in the calculations. Freely rotating molecules which possess the properties of a linear or spherical rotator and also arbitrary molecules with a preferred axis of free or hindered rotation are considered. (auth)

26077 ASYMPTOTIC FORM OF NEUTRON TRANSPORT EQUATIONS. Rakhmatulina, A. Kh. Zh. Vychisl. Mat. Mat. Fiz., 5: 218-35(1965).

The neutron-transport equation when the neutrons have constant energy values and energy exchange with the nuclei does not occur has the following form for the case of isotropic scattering in a homogeneous medium: $\partial f/\partial t = -v(n\nabla_r)[f - (v/l)][f + (vc/l)]\int_{n'} f(r,n',t)dn'$, (1); where r is the radius vector of the particles, n is the unit velocity vector, l is the free path length, and c is the number of secondary neutrons for one collision. The function f(r,n,t), a solution

of the Cauchy problem for equation (1) under the initial condition $f(r,n,0) = f0(r,n)$, satisfies the relation $f(r,n,t) = f_0(r - nvt,n)\ [e^{-vt/l} + (c/4\pi)]\ \int_0^{vt} \int_{n'} f[r - nu,n',t - (u/v)]\ e^{-u/l}(du/l)dn'$, (2). For a particle density $F(r,t) = (1/4\pi)\ \int_n f(r,n,t)dn$, $F(r,t) = (1/4\pi)\ \int_n f_0(r - nvt,n)dne^{-vt/l} + (c/4\pi)\ \int_n dn \int_0^{vt} F[r - nu, t - (u/v)]\ e^{-u/l}(du/l)$ is obtained, (2'). Series expansion of the second integral of (2') is carried out in order to investigate the asymptotic behavior of F(r,t) under the conditions $F(r) = (c/4\pi) \int_n dn \int_0^{\infty} F(r - nu)e^{-u/l}(du/l)$, (3). It is first established how closely F(r,t) can be approximated by the solution of the equation $\partial\phi/\partial t = D\Delta\phi - (D/L_0^2)\phi$. Then its approximation by the solution of the following equation is investigated: $\partial\Psi/\partial t = D\Delta\Psi + l^2(1/3D)(\partial^2\Psi/\partial t^2) + (3D/5)\Delta^2\Psi - \Delta(\partial\Psi/\partial t)]$. Finally, estimates are obtained for the time derivative, and expressions for neutron flux are derived. (ATD)

26078 BOTTLES FOR NEUTRONS. Foldy, Leslie L. (Case Inst. of Tech., Cleveland). pp 205-9 of Preludes in Theoretical Physics. Amsterdam, North-Holland Publishing Co., 1966.

A theoretical discussion of the problems to be encountered in the development of a neutron bottle is presented. A neutron bottle is defined as a cavity in a material substance such that neutrons filling this cavity will, under appropriate circumstances, be unable to escape through the walls at least for a time of the order of the neutron beta decay lifetime which is 12 minutes. Such a cavity is proposed theoretically in liquid helium with helium wall thickness greater than 6×10^{-5} cm and maintained at a temperature below 10^{-5}K would be capable of holding a neutron gas with a density of the order of 10^{14} neutrons/cm^3 with a loss rate which is comparable with that arising from spontaneous neutron decay. (B.G.D.)

26079 APPARATUS FOR THE PRODUCTION OF NEUTRONS WITH THE HELP OF NUCLEAR REACTIONS. Leboutet, Hubert; Warnecke, Robert R. (to Compagnie Generale de Telegraphie sans Fil). German Patent 1,207,516. Priority date Feb. 2, 1959, France.

The apparatus for producing neutrons by the impact of ions within an evacuated enclosure comprises means for effectively producing a continuous movement of ion beams within said enclosure including means for bunching and effectively reflecting the ion beams in such a manner that periodic encounters between bunches moving in opposite directions are established within at least one predetermined zone, and means for enabling the escape of neutrons produced. (Gmelin Inst.)

Nuclear Properties and Reactions

Refer also to abstracts 25393, 25796, 25938, 25942, 26372, 26383, and 26396.

26080 (BAW–393-5) NEUTRON CROSS SECTIONS FOR ^{233}U. Snidow, N. L. (Babcock and Wilcox Co., Lynchburg, Va. Atomic Energy Div.). Apr. 1966. Contract AT (38-1)-393. 67p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

^{233}U neutron cross sections are tabulated for 1198 energy points from 0.0001 ev to 10 Mev, and the sources of the values are given. The file is intended for use with a Fortran program in obtaining group average cross sections for dilute ^{233}U systems. In addition, 1/E weighted averages for a 68-group set are given. (auth)

26081 (IDO–17173) TECHNIQUES FOR DETERMINING ETA FOR THE THERMALLY FISSIONABLE ISOTOPES. Smith, J. Richard; Fast, Edwin (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). Apr. 1966. Contract AT(10-1)-205. 25p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Several types of experiments are reviewed as to their contributions to an understanding of the fission parameter η, the number of fission neutrons produced per absorption. The comparison of monochromatic values with spectrum-averaged values requires detailed understanding of the energy dependence involved. It is necessary to consider all evidence concerning both absolute value and energy dependence in order to obtain a consistent picture of either. (auth)

26082 (IDO–17174) THE FISSION CROSS SECTION OF ^{241}Pu FROM 20–200 ev AS DETERMINED FROM A NUCLEAR EXPLOSION. Simpson, O. D.; Fluharty, R. G.; Moore, M. S.; Marshall, N. H. (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.); Diven, B. C.; Hemmendinger, A. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). Apr. 1966. Contract AT(10-1)-205. 25p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

A nuclear explosion was used as a neutron source for a measurement of the neutron-induced fission cross section of ^{241}Pu. Over the region from 20 to 200 ev, the region of thermal neutron energies of the source, the flux was high enough to permit the determination of fission cross sections with a minimal error. A comparison of these data with previous measurements of the fission cross section of ^{241}Pu shows that a significant improvement was made, both in resolution and in statistical accuracy. The data below 60 ev were analyzed with the use of a multilevel formula. (auth)

26083 (ISS–65/49) CINEMATICA DELLA REAZIONE (e,e'p). (Kinematics of the (e,e'p) Reaction). Giucci, D. (Istituto Superiore di Sanita', Rome (Italy). Laboratori di Fisica). Dec. 23, 1965. 102p. Dep. mn.

The kinematics of collision between electrons and nucleons bound in a nucleus are described. A computing program, coded in FORTRAN IV for the IBM 7040 electronic computer, as well as some kinematic tables concerning the reaction produced by electrons on protons in a nucleus, is included. (auth)

26084 (JINR-P-2618) SPEKTR GAMMA-LUCHEI IZ RASPADA ^{141}Pm → ^{141}Nd. (Gamma-Ray Spectrum From ^{141}Pm → ^{141}Nd Decay). Arl't, R.; Bonch-Osmolovskaya, N.; Vrzal, J.; Liptak, J.; Urbanec, J. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1966. 7p. Dep. mn.

Results of gamma-spectrum measurements of ^{141}Pm are given. It is established that gamma-rays can be attributed to the ^{141}Pm decay, the absolute number of gamma-transitions per decay is determined, and the tentative decay scheme for ^{141}Nd is suggested. (auth)

26085 (JINR-P-2624) KOGERENTNOE OBRAZOVANIE π-MEZONOV V STOLKNOVENIYAKH π^--MEZONOV S IMPUL'SOM 3.85 GEV/C S YADRAMI FOTOEMUL'SII. (Coherent Production of π Mesons in 3.85-Gev/c π^- Collisions with Photoemulsion Nuclei). Shakhbazyan, B. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1966. 7p. Dep. mn.

It is shown that according to the existing selection criteria for the coherent $\pi \rightarrow 3\pi$ events, the upper limit of the cross section for this process on light emulsion nuclei is 0.5 mb. (auth)

26086 (LA-DC–7623) CAPTURE AND FISSION CROSS SECTIONS OF ^{240}Pu. Byers, D. H.; Diven, B. C.; Silbert, M. G. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). [1965]. Contract W-7405-eng-36. 15p. (CONF-660303–17). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From American Physical Society, Conference of Neutron Cross Section Technology, Washington, D. C.

The capture and fission cross sections of ^{240}Pu are presented in the energy interval 20 ev to 2-Mev. The results were obtained using the technique of neutron cross section measurement by the time-of-flight method employing a nuclear detonation as the pulsed neutron source. (auth)

26087 (LAL–1154) COULOMB FORM FACTORS OF ^{10}B AND ^{11}B. Stovall, T.; Goldemberg, J.; Isabelle, D. B. (Laboratoire de l'Accelerateur Lineaire, Univ. de Paris, Orsay (France)). Mar. 1966. 31p. Dep. mn.

The electron scattering cross section of ^{10}B and ^{11}B was measured at incident energies of 198.5, 333, and 400 Mev for various scattering angles. The data were analysed so as to yield values of the mean squared charge radius and

the nuclear quadrupole moment. Several nuclear models are considered. (auth)

26088 (NYO–72–73) CINDA: AN INDEX TO THE LITERATURE ON MICROSCOPIC NEUTRON DATA. Supplement 2, [Cumulative]. (Columbia Univ., New York. ENEA Neutron Data Compilation Centre, Gif-sur-Yvette (France)). Mar. 1, 1966. Contract AT(30-1)-72. 435p. (EANDC–54(U); CCDN-CI–7). DTI Extension.

This second supplement to the 1965 (CINDA cumulation, which should be used in conjunction with the main volume, replaces completely the first supplement and contains all additions and corrections entered into the CINDA master library tape during the period May 1, 1965, to March 1, 1966. The entries are arranged by element or isotope, cross section, energy range, report or journal reference, type of reference, originating laboratory or organization, and comments (or values). (L.T.W.)

26089 (ORNL-3839) PREPARATION OF ^{131m}Xe, ^{129m}Xe, AND ^{79}Kr. Acree, E. H. (Oak Ridge National Lab., Tenn.). May 1966. Contract W-7405-eng-26. 15p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Xenon-131m and xenon-129m were prepared from iodine isotopes by secondary neutron capture, and krypton-79 was prepared by utilizing the (n,γ) reaction on krypton gas enriched to ~7% in ^{78}Kr. A three-month irradiation of a 20-mg target of ^{129}I at a flux of 2×10^{14} n/cm^2 · sec produced 9.8 mC of ^{131m}Xe. Irradiation of 20 mg of ^{127}I for one month yielded 0.14 mC of ^{129m}Xe. A 1 cc (STP) enriched krypton target provided ~1.2 mC of ^{79}Kr product of >99% purity. (auth)

26090 (ORNL–3934) ELASTIC AND INELASTIC SCATTERING OF 12.7-Mev PROTONS FROM ^{90}Zr, ^{92}Zr, AND ^{94}Zr: TABULATED DIFFERENTIAL CROSS SECTIONS. Dickens, J. K.; Eichler, E.; Silva, R. J.; Chilosi, G. (Oak Ridge National Lab., Tenn.). May 1966. Contract W-7405-eng-26. 37p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Numerical values of differential cross sections for elastic and inelastic scattering of 12.7-Mev protons from ^{90}Zr, ^{92}Zr, and ^{94}Zr are reported in tabular form. Cross sections were determined at 5° intervals between laboratory angles of 20 and 165°. Inelastic-scattering data are reported for twenty excited states of ^{90}Zr (Q = –1.75, –2.18, –2.32, –2.74, –3.09, –3.31, –3.45, –3.63, –3.84, –3.97, –4.07, –4.12, –4.23, –4.33, –4.50, –4.57, –4.70, –4.82, –5.02, and –5.13 Mev); for twelve excited states of ^{92}Zr (Q = –0.93, –1.37, –1.50, –1.85, –2.07, –2.19, –2.35, –2.50, –2.76, –3.08, –3.28, and –3.49 Mev); and for eleven excited states of ^{94}Zr (Q = –0.916, –1.30, –1.47, –1.66, –2.06, –2.32, –2.36, –2.62, –3.16, –3.24, and –3.92 Mev). (auth)

26091 (ORNL-P–1203) THE ^{90}Zr(d,p)^{91}Zr REACTION AT ENERGIES BELOW 4 Mev. Brient, Charles E.; Hudspeth, Emmett L.; Bernstein, E. M. (Texas Univ., Austin); Smith, William R. (Oak Ridge National Lab., Tenn.). [1964]. Contract W-7405-eng-26. 45p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Angular distributions and excitation functions of protons arising from the ^{90}Zr(d,p)^{91}Zr reaction were obtained that correspond to the ground state and 1.215, and 2.07-Mev levels of ^{91}Zr. The results indicate that below a certain energy the DWBA theory breaks down and that above this energy it may be valid. The angular distributions vary smoothly but considerably in the energy range 2.7 to 3.5 Mev, and these changes are not reproduced by employing energy-independent optical-model parameters. The parameters that explain the 3.5-Mev angular distributions are consistent with parameters obtained from the study of higher energy deuteron and proton elastic-scattering data. The predicted spectroscopic factors, however, are too large. (auth)

26092 (ORNL–P–2072) FILLING IN GAPS WITH CROSS SECTIONS CALCULATED FROM THEORY. Perey, F. G. (Oak Ridge National Lab., Tenn.). [1964]. Contract W-7405-eng-26. 15p. (CONF-660303–27). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From American Physical Society, Conference of Neutron Cross Section Technology, Washington, D. C.

The usefulness of nuclear model cross section calculations for elastic and inelastic scattering of neutrons with energy less than 16 Mev is discussed. (M.O.W.)

26093 (ORNL-P-2106) NEUTRON CROSS SECTIONS IN THE ENERGY RANGE 100 ev < E_n < 100 kev: RECENT PROGRESS, CURRENT STATUS, FUTURE OUTLOOK. Gibbons, J. H. (Oak Ridge National Lab., Tenn.). [1966]. Contract W-7405-eng-26. 39p. (CONF-660303-28). Dep. mn. CFSTI $2.00 cy, $0.50 mn.

From American Physical Society, Conference of Neutron Cross Section Technology, Washington, D. C.

The technology of measuring cross sections in the energy range 100 ev < E_n < 100 kev has advanced significantly over the past several years. The most notable developments have occurred in detectors for capture cross section measurements, available neutron energy resolution in general, and absolute values for flux normalization. Reactor design needs for total and capture cross sections can apparently be met with existing or feasible equipment. The primary exceptions to this statement are highly radioactive materials and some of the higher accuracy requests. Reaction theory and measured reaction systematics are insufficiently understood to enable more than an educated guess at unmeasured capture cross sections. (auth)

26094 (ORNL–P–2117) AN INVESTIGATION OF (p,n) REACTION MECHANISM VIA ISOSPIN ANALOG RESONANCES. Kim, H. J.; Robinson, R. L. (Oak Ridge National Lab., Tenn.). [1965]. Contract W-7405-eng-26. 13p. (CONF-660306–5). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From American Physical Society Conference on Isobaric Spin, Tallahassee.

An investigation was made of the excitation functions and angular distributions of neutron groups produced by the (p,n) reactions on ^{88}Sr and ^{89}Y in the energy region of well established $d_{3/2}$ isolated resonances. These resonances are due to the isobaric analogues of the $d_{5/2}$ neutron states of ^{89}Sr and ^{90}Y. The neutron groups feeding the ground state of ^{89}Y, ground state of ^{89}Zr, and 590 kev state of ^{89}Zr were detected by time-of-flight methods in conjunction with a pulsed proton beam accelerated by the ORNL 5.5 Mev Van de Graaff accelerator. (M.O.W.)

26095 (SGAE-PH–34/1965) KERNPHYSIKALISCHE ARBEITEN IM REAKTORZENTRUM SEIBERSDORF. (Nuclear Physical Studies at the Seibersdorf Reactor Center). Weinzierl, Peter (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf). 1965. 28p. Dep. mn.

A review is given of the principal areas of investigation undertaken at the Seibersdorf Reactor Center. Among the studies discussed are the design and development of an electromagnetic mass separator, measurement of neutron capture cross sections, neutron decay, and the prompt γ scattering in nuclear fission. Typical results are given. (J.S.R.)

26096 (TID–22889) NEUTRON PRODUCTION IN D_2O FROM DELAYED GAMMA RAYS PRODUCED IN THERMAL FISSION OF ^{235}U. Final Progress Report, June 1965–December 1965. Onega, Ronald J. (Virginia Polytechnic Inst., Blacksburg. Dept. of Physics). Contract AT(40-1)-3409. 18p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

The neutron production in D_2O from delayed gamma rays produced in the thermal fission of ^{235}U was investigated. A small sample of ^{235}U was placed in a small sphere of D_2O and irradiated for various times. The irradiation time is determined by a neutron chopper. Some preliminary results are given. (M.O.W.)

26097 (UCRL–14568) NEUTRON CROSS SECTIONS INFERRED FROM CHARGED PARTICLE DATA. Lutz, H. F.; Anderson, J. D. (Lawrence Radiation Lab., Univ. of California, Livermore). Mar. 3, 1966. Contract W-7405-eng-48. 14p. (CONF-660303–3). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From American Physical Society, Conference of Neutron Cross Section Technology, Washington, D. C.

The possibility of using charged particle data together

with various nuclear models to generate neutron data is explored. A general description of the interaction of nucleons with matter in terms of specific models (optical model, extended optical model, charge independence and charge symmetry) is presented, along with enough data to indicate their general usefulness in generating neutron cross sections. As a specific example light nuclei are dealt with, and the application of charge symmetry and charge independence is presented in detail. (auth)

26098 (AECL-2330, pp 255-83) THE SCATTERING OF SLOW MONOCHROMATIC NEUTRONS IN MONOISOPROPYLDIPHENYL AT A TEMPERATURE OF 17 ± 2°C. Mostovoi, V. I.; Sadikov, I. P.; Chernyshov, A. A.; Eremeev, I. P. Translated from pp 211-35 of Issledovaniya po Primeneniyu Organicheskikh Teplonositelei-Zamedlitelei v Energeticheskikh Reaktorakh, Atomizdat, Moscow, 1964.

The results of measurements of the cross sections of inelastic scattering of neutrons on monoisopropylbiphenyl at room temperature are presented. The purpose of this investigation was to determine the thermalizing properties of monoisopropylbiphenyl and to compare them with the thermalizing properties of water. The results are given in the form of graphs which represent the ratio of the second derivative of the cross section to the total scattering cross sections of free atoms, which are molecules of monoisopropylbiphenyl. In addition, the mean characteristics of neutron scattering on monoisopropylbiphenyl are also calculated. It is shown that the general character of scattering on monoisopropylbiphenyl is similar to that of scattering on water. The thermalizing capacity of monoisopropylbiphenyl, however, is less than that of water. The mean cosine for monoisopropylbiphenyl is also shown to lie considerably below that of water. The generalized frequency spectrum is also calculated. On the whole, the energy of the generalized spectrum in monoisopropylbiphenyl is less than that in water. (ATD)

26099 (ORNL-tr-1102) THE NATURE OF INTERACTION IN HEAVY ATOMIC NUCLEI. Euler, H. Translated for Oak Ridge National Lab., Tenn., from Z. Phys., 105: 553-75(1937). 28p. Dep. mn. JCL $2.60 fs, $1.04 mf.

The mean mass defects of heavy atomic nuclei are calculated in an approximation which extends by one step beyond the Thomas-Fermi method. Since the mass defects obtained in this approximation are much closer to the empirical ones, than those obtained from the Thomas-Fermi method, the results of this study can serve as an argument for the new assumptions concerning nuclear forces, which were proposed by Breit, Condon, Present, Feenberg and by Volz. (auth)

26100 MOESSBAUER EFFECT IN ^{159}Tb. Czibok, T.; Dezsi, I.; Keszthelyi (Central Research Inst. for Physics, Budapest). Acta Phys. Acad. Sci. Hung., 20: 379-81(1966).

A study was made of the Mössbauer effect on the 58-kev first-excited state of ^{159}Tb. The maximum of the nuclear absorption was found to be (15 ± 1)%, and the lower limit for the half life of the 58-kev state was found to be (3 ± 0.3) 10^{-11} sec. (L.B.S.)

26101 ANGULAR DISTRIBUTIONS OF THE TRANSFER REACTION PRODUCTS. Kalinkin, B. N.; Grabowski, J. (Joint Inst. for Nuclear Research, Dubna, USSR). Acta Phys. Pol., 29: 503-6(Apr. 1966).

The following problems concerning the angular distributions of the products of the one- and two-nucleon transfer reactions are considered: the dependence of the angular distributions on the parameter responsible for the absorption, the energy dependence of the width of the main peak, and the form of the angular distribution in the limit $\theta \to 0°$. (auth)

26102 STUDY OF HYPERFRAGMENTS PRODUCED BY 800-Mev/c K^-. I. STATISTICAL ANALYSIS OF HEAVY HYPERFRAGMENTS. Doporto, M. P.; Senent, F.; Villar, E. (Facultad de Ciencias, Valencia). An. Real Soc. Espan. Fis. Quim. (Madrid), Ser. A, 61: 331-6(Nov.-Dec. 1965).

A quantitative study was made of short-range hyperfragments. A stack of Ilford K5 emulsion plates was exposed to an 800-Mev/c meson (K^-) beam. The variation of various parameters of the production and decay processes with the number of heavy ionizing tracks in the parent star was studied in order to investigate the process of hyperfragmentation. The angular distribution of hyperfragments with respect to the beam direction and the mean range versus the number of heavy ionizing tracks in the parent star are shown. Also a table is given for the events found showing their various parameters. (J.F.P.)

26103 MAGNETIC ANALYSIS OF THE REACTIONS ^{12}C(d,p)^{13}C AND ^{16}O(d,p)^{17}O. Garcia, A.; Bolta, J. M.; Lopez, A.; Senent, F. (Facultad de Ciencias, Valencia). An. Real Soc. Espan. Fis. Quim. (Madrid), Ser. A, 61: 341-8(Nov.-Dec. 1965). (In Spanish).

The ^{12}C(d,p)^{13}C and ^{16}O(d,p)^{17}O reactions are studied using a multichannel magnetic spectrograph. The monoenergetic proton groups corresponding to ground state and first three low-lying levels of ^{13}C and ^{17}O nuclei were identified. The relative differential cross sections and angular distributions were calculated for all these states within the angular interval from 5 to 175°; the results are compared with the predictions of the Butler stripping theory. (auth)

26104 MAGNETIC ANALYSIS OF THE REACTION ^{51}V(d,p)^{52}V. II. HIGHER EXCITATION OF THE LEVELS ^{52}V(3.66-4.75 Mev). Garcia, A.; Bolta, J. M.; Lopez, A.; Senent, F. (Facultad de Ciencias, Valencia). An. Real Soc. Espan. Fis. Quim. (Madrid), Ser. A, 61: 349-56(Nov.-Dec. 1965). (In Spanish).

Carrying on a study of the ^{51}V(d,p)^{52}V reaction, using a multichannel magnetic spectrograph, the excitation energy interval of ^{52}V nucleus were analyzed from 3.66 to 4.75 Mev. Within this interval, 25 levels of that nucleus were found, 19 of these are not mentioned for the first time. The corresponding differential cross sections and angular distributions are calculated covering the angular range from 5 to 87°30′. (auth)

26105 THE POLARIZATION OF ^{3}He PARTICLES SCATTERED FROM C, Al, Cu, Sn AND Au AT 26-29 Mev. Catala, J.; Garcia, A.; Perez, J. M. (Facultad de Ciencias, Valencia). An. Real Soc. Espan. Fis. Quim. (Madrid), Ser. A, 61: 357-60(Nov.-Dec. 1965).

Helium-3 polarization measurements were made using double-scattering experiments in which 29-Mev helium-3 particles were elastically scattered first from carbon and then from carbon, aluminum, copper, tin, and gold. The plates were scanned for doubly charged particles. Left-right histograms for double helium-3 scattering by carbon and by carbon and gold are given, and absolute values for the polarization of helium particles by carbon, aluminum, copper, tin, and gold are shown. (J.F.P.)

26106 METHOD FOR DISCRIMINATING BETWEEN HIGH-ENERGY PROTON INTERACTIONS WITH LIGHT AND HEAVY NUCLEI IN PHOTOGRAPHIC EMULSIONS. Villar, E.; Gomez, J. L.; Senent, F. (Facultad de Ciencias, Valencia). An. Real Soc. Espan. Fis. Quim. (Madrid), Ser. A, 62: 45-50(Jan.-Feb. 1966). (In Spanish).

A graphical method is used to decide whether a light or heavy nucleus has interacted with a high-energy proton. The method is justified using a simple optical model. Good agreement is found between the theoretical and experimental cross sections. (auth)

26107 POLARIZATION AND ALIGNMENT OF SPIN-ONE STATES. Mullin, C. J. (Univ. of Notre Dame, Ind.). Ann. Phys. (N. Y.), 37: 55-61(Mar. 1966). (COO-427-49).

A geometrical discussion of the polarization and alignment of spin-one states is given. An arbitrary pure state is described by two unit vectors. It is shown that a pure state can be decomposed into two orthogonal parts, one of which is completely polarized and the other of which is completely aligned. For mixed states measures of the degree of purity and of the relative amount of polarization and alignment are given. (auth)

26108 VARIATIONAL APPROACH TO THE NUCLEAR PAIRING-CORRELATION PROBLEM. Wahlborn, S. Ark. Fys., 31: 33-57(1965).

The pairing-correlation theory plays an essential role in the description of nuclear spectra at low energies. The BCS-approximation, commonly used for the treatment of the quasi-particle excitations, has uncertainties due to the fluctuations in the particle number. A variational method was formulated in which the problem is solved approximately without such inherent error, by using an expansion of the eigensolutions in terms of the unperturbed pair configurations. The approach (called Varapp), which is adequate for the lowest pairing-eigenstate of actual nuclei, is based on the following assumptions: (1) Configurations, involving the excitation of one pair, are treated exactly. (2) Configurations with the excitation of two pairs, are included in an average fashion by means of an energy dependent amplitude function. (3) Configurations with three or more excited pairs are neglected. The method is applied for calculating the energies in various cases of a model system with uniform level distribution and 16 or 17 particles. The solutions are obtained numerically, by the aid of a computer. The accuracy turns out to be satisfactory; for realistic cases the energy error is practically negligible compared to that of the BCS-solution. The BCS-energies are calculated (with blocking) for the same cases, and their error is found to be rather independent of the blocking. As a result, BCS gives a fair approximation considering the excitation energies in the various cases (both odd and even systems). On the other hand, a significantly poor approximation results, if blocking is not accounted for. This conclusion concerning the use of the BCS-theory is of importance for nuclear-structure calculations. In particular, the average energy gap of even nuclei in the rare-earth region is estimated to have a value of about 1.4 Mev, in fair agreement with experimental systematics. (auth)

26109 NUCLEAR SPIN AND MAGNETIC MOMENT OF THE GROUND STATE OF ^{52}Mn. Aedelroth, K. E.; Lindgren, I.; Djay, R.; Rosen, A. Ark. Fys., 31: 549-54(1966).

The atomic-beam magnetic resonance method was used to measure the spin and the hfs of the ground state of ^{52}Mn (5.7d) with the result I = 6, a = 26.759 (3) MHz and |b| <0.100 MHz. The magnetic dipole moment is calculated from the measured hfs and the known values of ^{55}Mn to be μ_I = (+) 3.075 (1) n.m. (auth)

26110 STUDY OF LEVELS IN ^{51}Mn AND ^{53}Mn THROUGH THE RADIATIVE CAPTURE OF PROTONS BY ^{50}Cr AND ^{52}Cr. Sterner, S.; Jonsson, L.; Arnell, S. E. (Chalmers Univ. of Tech., Goteborg). Ark. Fys., 31: 567-73(1966).

The gamma de-excitation of some resonances in the ^{50}Cr(p,γ)^{51}Mn and ^{52}Cr(p,γ)^{53}Mn reactions was studied with a Ge(Li)-spectrometer. More accurate level energies and a few new excited states are reported. (auth)

26111 THE ^{48}Ca(p,γ)^{49}Sc REACTION. Dubois, J.; Maripuu, S.; Almen, O. (Chalmers Univ. of Tech., Goteborg). Ark. Fys., 31: 65-81(1966).

The ^{48}Ca(p,γ)^{49}Sc reaction was studied in the 800–1400 kev proton energy range. Sixty-six resonances were found. From the gamma ray de-excitation levels at 2.22, 2.34, 3.10, 3.50, 3.93, 4.10, 4.96 Mev and probably also a level at 3.96 Mev were established and their branching ratios were measured. Double and triple angular correlation measurements suggest a $5/2$ spin value for the 2.22 Mev level and $3/2$ or $5/2$ for the 2.34 Mev level. Spin assignments for some resonance levels are also given. (auth)

26112 INELASTIC SCATTERING OF PROTONS BY ^{36}Ar, ^{38}Ar, AND ^{40}Ar. Skeppstedt, O.; Jonsson, L.; Hasselgren, A.; Arnell, S. E. (Chalmers Univ. of Tech., Goteborg). Ark. Fys., 31: 83-90(1966).

The excitation functions of the reactions ^{36}Ar(p,p'γ)^{36}Ar, ^{38}Ar(p,p'γ)^{38}Ar and ^{40}Ar(p,p'γ)^{40}Ar were studied in the range of incident proton energies from 2.5 to 5 Mev by observing the gamma radiations arising from the first excited states of ^{36}Ar, ^{38}Ar and ^{40}Ar respectively. The angular distributions of the gamma rays followed inelastic scattering of protons by ^{36}Ar have given information of spins and parities of ^{37}K states. (auth)

26113 GAMMA DECAY OF RESONANCES IN ^{23}Na. Wernbom-Selin, E.; Arnell, S. E. (Chalmers Univ. of Tech., Goteborg). Ark. Fys., 31: 113-44(1966).

The gamma de-excitation of a number of resonances in the ^{22}Ne(p,γ)^{23}Na reaction was investigated with NaI- and Ge(Li)-spectrometers. The gamma decay schemes of the first eleven excited states of ^{23}Na were studied. Coincidence measurements established the branching ratios. Spin values are assigned to some of the capturing states and low excited states from angular correlation measurements. (auth)

26114 ON THE SYSTEMATICS OF M4 TRANSITIONS OF THE TYPE $g_{9/2} \rightleftharpoons p_{1/2}$. DECAY OF ^{109m}In AND ^{111m}In. Martinson, I.; Johansson, N.G.E.; Borg, S.; Alvaeger, T. (Univ. of Stockholm). Ark. Fys., 31: 307-18(1966).

The M4 transitions between the levels $g_{9/2}$ and $p_{1/2}$ were re-analyzed. The empirical matrix elements of these transitions are remarkably uniform for indium isomers, whereas a decrease with increasing neutron number is evident for other elements. The M4 transitions in ^{109}In and ^{111}In were investigated by electron and gamma ray spectroscopy, using electromagnetically isotope separated samples. The following data were obtained: ^{109m}In: $T_{1/2}$ = 1.35 ± 0.20 min, E_γ = 658 ± 3 kev; and ^{111m}In: $T_{1/2}$ = 7.3 ± 0.5 min, E_γ = 539 ± 2 kev. (auth)

26115 THE NUCLEAR PAIRING-CORRELATION MODEL. II. ONE-BODY MATRIX ELEMENTS AND PAIRING WAVE-FUNCTIONS. Wahlborn, S. (Royal Inst. of Tech., Stockholm). Ark. Fys., 31: 319-33(1966).

General relations are presented for the matrix elements of one-body multipole operators in the pairing-correlation model (PCM) of nuclei. The effect of the pairing can be represented by exact expressions, having a simple form, analogous to that obtained in the BCS-theory. The relations are used in a study of the wave functions, evaluated by the variational approach (Varapp), presented in a previous article, which is considered as part I of this work. The result is compared with the BCS-approximation (with blocking). It is found that the Varapp-solution reproduces the diffuseness of the Fermi surface fairly well; the same is true of the BCS-solution when it is non-trivial ($\Delta > 0$). Furthermore, the BCS-values of transition matrix-elements tend to be somewhat too heavily affected by the pairing-correlations. The results are of interest for the application of the PCM in nuclear-structure calculations. (auth)

26116 QUASI-PARTICLE DESCRIPTION OF MULTIPOLE TRANSITIONS IN THE LEAD REGION. Wahlborn, S.; Martinson, I. Ark. Fys., 31: 355-80(1966).

In analyzing the data on multipole transition-probabilities in odd-A nuclei, it is of interest to know the one quasi-particle matrix elements. For a realistic evaluation of these in the lead region, the following quantities were computed: (1) The radial factors, using the wave functions obtained previously from a diffuse potential. (2) The pairing-factors, using the BCS-approximation (with blocking). These factors are tabulated for most cases of interest in the region. It is found that the radial factors fluctuate considerably, and that the pairing-correlations may modify the matrix elements significantly (particularly important for E2 and M4). The available information about absolute rates for M1, E2, E3, and M4 transitions is discussed, using the calculated transition probabilities. The data show a fairly clear distinction between transitions, which are found to have quasi-particle rates, and such which are too heavily enhanced or hindered to enable a quasi-particle interpretation. In the first category, empirical values of effective changes (E2) and nuclear magnetic g-factors are determined and turn out to have reasonable values. In addition to rates in odd-A nuclei, also signs of δ-ratios are considered, as well as transition rates between odd-group levels in odd-odd nuclei. (auth)

26117 THE ^{48}Ca(p,nγ)^{48}Sc REACTION AND LOW LYING LEVEL IN ^{48}Sc. Dubois, J. (Chalmers Univ. of Tech., Goteborg). Ark. Fys., 32: 65-77(1966).

The gamma rays from the $^{48}Ca(p,n\gamma)^{48}Sc$ reaction were studied in the 1000–1350 kev proton energy range using NaI and Ge detectors. Levels in ^{48}Sc at 131 ± 1, 252 ± 2, and 623 ± 2 kev were established and a lower limit for the Q-value is given. The present experimental data on low lying levels in ^{48}Sc seem to be in close agreement with predictions from the many particle shell model. (auth)

26118 SPIN ASSIGNMENTS OF SOME LEVELS IN ^{43}Sc. Broman, L.; Dubois, J.; Holmen, G. (Chalmers Univ. of Tech., Goteborg). Ark. Fys., 32: 407-16(1966).

Double and triple angular correlation measurements performed at several resonances in the $^{42}Ca(p,\gamma)^{43}Sc$ reaction are given. The following spin and parity assignments are suggested from these and other measurements: 150 kev level, $3/2^+$; 472 kev, $3/2^-$; 844 kev, $5/2^+$; 1175 kev, $1/2^-$. Furthermore a $1/2$-value for the 877 kev level and a $3/2$ or $5/2$-value for the 1649 kev level are proposed. These results are in good agreement with the cluster model predictions. In addition, the 1013 kev resonance is found to have spin $1/2$ and the 1157, 1280 and 1421 kev resonances most probably have spin $5/2$. A coincidence experiment, in which the proton beam energy was swept on and off resonance, was used to show that the 877 kev level decays to the isomeric level at 150 kev. (auth)

26119 NOTE ON THE MAGNETIC PROPERTIES OF THE GROUND STATE ROTATIONAL BAND OF ^{169}Tm. Sparrman, P.; Sundstroem, T.; Lindskog, J. Ark. Fys., 31: 409-12(1966).

The electromagnetic properties of the ground state rotational band of ^{169}Tm were reconsidered. It is shown that, with the experimental data presently available, the Nilsson model can be very successfully applied to describe these properties. (auth)

26120 ANALYSIS OF THE $T(p,n)^3He$ REACTION. El-Nadi, M.; Rabie, A. (Atomic Energy Establishment, Cairo). Atomkernenergie, 11: 233-7(May-June 1966).

Experimental data on the $T(p,n)^3He$ reaction were analyzed theoretically on the basis of the three-body model for T and ^3He nuclei. Good results were obtained using the zero-range approximation, and neglecting the Coulomb distortion effect. (auth)

26121 REACTION (d,p) ON ^{30}Si AT LOW DEUTERON ENERGY. El-Zaiki, M. I.; Baranik, A. T.; Abuzeid, M. A.; Zaloubovsky, I. I. (Atomic Energy Establishment, Cairo). Atomkernenergie, 11: 238-41(May-June 1966).

Measurements were made of the excitation functions for the first two groups of protons from $^{30}Si(d,p)^{31}Si$ in the energy range from 1.5 to 2.5 Mev at angles of 30 and 150°. Intensive uncorrelated resonances were observed in the excitation curves for both the groups, the angular distributions measured at nine deuteron energies showed clear evidence for two reaction mechanisms, the compound nucleus process and the direct interaction process. The fitting of the angular distribution shape was made taking into account the compound, direct, and interference processes. Differential and total cross sections of the reaction were determined for P_0 and P_1 groups. (auth)

26122 PROBLEMATICS OF THE ELECTRON CAPTURE DECAY. Berenyi, D. ATOMKI (Atommag Kut. Intez.) Kozlem., 7: 179-82(Dec. 1965).

Deviations between experimental and theoretical results for the branching between electron capture and positron emission in first-order nonunique forbidden and higher-order forbidden beta transitions and for the K/L ratios in allowed transitions are discussed. The search currently being performed for a predicted anomaly in the shape of the internal bremsstrahlung spectrum accompanying electron capture in ^{36}Cl is reported. (M.J.T.)

26123 THE EVALUATION OF THE MEASUREMENTS FOR FINDING THE KOH ANOMALY IN THE SPECTRUM OF INTERNAL BREMSSTRAHLUNG ACCOMPANYING THE ELECTRON CAPTURE DECAY OF ^{36}Cl. Berenyi, D. ATOMKI (Atommag Kut. Intez.) Kozlem., 7: 183-99(Dec. 1965). (In Hungarian).

The internal bremsstrahlung accompanying the electron capture decay of ^{36}Cl was studied near the end-point energy of the spectrum (from 882 kev), using a large, low-background NaI–Tl scintillation counter. No Koh anomaly was observed in the shape factor of the internal bremsstrahlung spectrum. The shape factor was found constant for the nonunique second-forbidden transition in the region examined, c(k) = const. (1 ± 0.03). The total disintegration energy of the $^{36}Cl \rightarrow {}^{36}S$ decay was determined to be 1158 ± 18 kev. As a control, the internal bremsstrahlung spectrum of the allowed electron capture decay of ^{55}Fe was studied; an end-point energy of 218 ± 4 kev and a shape factor of c(k) = const. (1 ± 0.01) were found. (M.J.T.)

26124 EXPECTED p^g-RADIOACTIVE ISOTOPES OF THE Z = 51 – 81 ODD ATOMIC NUMBER ELEMENTS. Daroczy, S. ATOMKI (Atommag Kut. Intez.) Kozlem., 7: 201-7(Dec. 1965). (In Hungarian).

Estimates are given for the half lives and proton energies of odd-Z radioisotopes with Z = 51 to 81, decaying via proton emission from the ground state (p^g decay). For the p^g decay of these radioisotopes having p-partial half lives from 10^{-10} to 1 sec, proton energies from 0.6 to 2.3 Mev are predicted. Possibilities of observing p^g-radioactive nuclei are considered. (M.J.T.)

26125 COUPLING OF A NUCLEON TO ANHARMONIC SURFACE VIBRATIONS. Quesne, C. (Univ. Libre, Brussels). Bull. Cl. Sci., Acad. Roy. Belg. (5), 51: 842-50 (1965). (In French).

The spectrum of ^{63}Cu was calculated by an intermediate-coupling approximation using the Kerman-Shakin model to describe the anharmonic vibrations of the ^{62}Ni core. The wave functions were compared with those obtained with the assumption of a harmonic core and were found to be not much different from them. As a consequence the discrepancy between the experimental and theoretical E2 de-excitation probabilities to the ground state remains unchanged. (auth)

26126 POSSIBILITY OF OBTAINING UNEXCITED COMPOUND NUCLEI OF HEAVY TRANSURANIC ELEMENTS. Maly, Ya. (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Rez). Dokl. Akad. Nauk SSSR, 165: 792-5(Dec. 1, 1965). (In Russian).

The excitation energy of the compound nucleus produced by bombarding ^{90}Zr, ^{178}Hf and $^{264}104$ targets with various ions whose atomic numbers range from 1 to 50 are calculated. The purpose of the investigation was to determine the conditions under which the unexcited heavy compound nuclei can be produced by means of the (ion, xn) reaction with simultaneous reduction of the number of evaporated neutrons, since neutron evaporation competes with fission and makes production of the heavy unexcited nuclei difficult. The calculations show that by bombarding medium-weight targets with medium-weight ions (a process opposite to fission) it is possible to obtain very heavy elements in the form of unexcited compound nuclei. Accelerators capable of obtaining very heavy ions, up to ^{136}Xe, will make practical realization of such nuclei possible. (ATD)

26127 COHERENT INTERACTIONS OF HIGH-ENERGY PIONS WITH COMPLEX NUCLEAR EMULSION NUCLEI. Azimov, S. A.; Beter, E. V.; Gulyamov, U. G.; Eroshkina, N. B.; Levin, A. Ya. (Inst. of Nuclear Physics, Academy of Sciences, Uzbek SSR). Dokl. Akad. Nauk UzSSR, No. 1, 22-5(1966). (In Russian).

The coherent inelastic interaction $\pi^- + A \rightarrow \pi^- + \pi^+ + \pi^- + A'$, where A is an emulsion nucleus, was studied in the irradiation of Ilford G-5 emulsions by a 17.2-Bev/c pion beam for cases with a primary track length of 1760 m. Measured distributions of the interactions with respect to the invariant mass of the system of three secondary pions and with respect to the transverse momentum transfer to the target nucleus are shown for momentum transfers from 0 to 500 Mev/c and compared with distributions calculated according to various laws. The dominant reaction mechanism is found to be the diffraction mechanism with basic contribution from the heavy emulsion nuclei. (M.J.T.)

26128 SLOWING-DOWN SPECTRUM OF ^{198}Au BETA RAYS IN GOLD. McConnell, W. J.; Hubbell, H. H. Jr.; Birkhoff, R. D. (Oak Ridge National Lab., Tenn.). Health Phys., 12: 693-8(May 1966). (ORNL-P-1459).

The Keplertron, a spherical electrostatic electron spectrometer, was used to obtain the slowing-down spectrum of beta rays and their secondary electrons in gold. Two gold discs 0.82 cm in diameter and 0.025 cm thick were irradiated in the LITR at ORNL to about 25 c. One disc was placed tangent to the inner Keplertron sphere and the other parallel and coaxial at a distance of 0.24 cm. The cylindrical cavity thus formed approximated a black body source with the electrons emerging from the open cylindrical sides being representative of flux in an infinite, isotropic, uniformly irradiated medium. Electron flux measurements were made from 1 ev to 63 kev. The spectrum, corrected for surface barrier transmission and spurious spectrometer response due to scattering, was compared on an absolute basis with the simplified continuous slowing-down model of Spencer and Attix. Flux varies from 2.9×10^{-8} electrons cm^{-2} ev^{-1} per primary beta ray cm^{-3} at 63 kev to 1.2×10^{-4} at 11 ev above the bottom of the conduction band. (auth)

26129 ON THE THEORY OF MULTIPLE COULOMB EXCITATION. Simonius, M.; Bierter, W.; Zwicky, A.; Alder, K. (Univ. of Basel). Helv. Phys. Acta, 38: 669-90(1965).

The theory of multiple Coulomb excitation is extended. The investigation of deviations from the sudden approximation, the computation of the multiple excitation of an asymmetric rotator, and an improved method for the treatment of coupled rotational bands are considered. Furthermore formulas for the angular distribution of de-excitation gamma rays are derived. Numerical results of sample calculations are discussed. (auth)

26130 MULTIPLE EXCITATION OF COLLECTIVE NUCLEAR STATES BY INELASTIC SCATTERING. Bierter, Willy (Univ. of Basel). Helv. Phys. Acta, 38: 736-52(1965).

An explicit WKB-solution of a system of coupled differential equations is presented where the adiabatic approximation was assumed to be valid. The optical model is extended to include nonspherical potentials so that inelastic scattering to low-lying collective nuclear states are induced which are strongly coupled to the nuclear ground state. Calculations are given for the multiple excitation of collective quadrupole vibrational states by inelastic scattering of alpha particles. In all calculations the effects of Coulomb excitation were taken into account. (auth)

26131 n-γ ANGULAR CORRELATIONS FOR $^{24}Mg(n,n'\gamma)_{1,368}$ AND $^{56}Fe(n,n'\gamma)_{0,845}$ AT 3.3 Mev AND 3.5 Mev. Steiger, Max Paul (Eidgenoessische Technische Hochschule, Zurich). Helv. Phys. Acta, 39: 107-43(1966). (In German).

Angular correlations between neutrons inelastically scattered to the first excited state and de-excitation γ rays were measured at 3.3 and 3.5 Mev for the reactions $^{24}Mg(n,n'\gamma)_{1,368}$ and $^{56}Fe(n,n'\gamma)_{0,845}$. The experiments were undertaken with ring geometry using a fast-slow coincidence circuit. Each of the correlation functions $W(\theta_{n'},\theta_\gamma, \Phi = 0)$ was determined at scattering angles $\theta_{n'} = 35°$ and 50° (and at 65° for ^{24}Mg at 3.3 Mev) for γ-emission angles θ_γ between 155° and 100° as well as at the supplementary angles $\theta_{n'} = 145°$ and 130° (and at 115°) for supplementary θ_γ-angles. Altogether 88 values (= 44 symmetric pairs) were measured as a basic test of symmetries inherent in the CN-theory. In general the results show fair agreement with the predictions of the CN-model. In the case of ^{24}Mg at 3.3 Mev (maximum in the γ-excitation function) the rather marked departures from symmetry, as also the smaller deviations at 3.5 Mev despite their evincing systematic trend, were mainly attributed to fluctuation effects arising from a failure of the statistical assumption. Slight asymmetries displayed by the results for ^{56}Fe are probably in part occasioned by similar fluctuations but indicate the likelihood of competition from the DI-mechanism. Theoretical CN n'-γ-angular correlation surfaces were calculated for both isotopes at 3.3 and 3.5 Mev using transmission coefficients from the Perey and Buck nonlocal optical potential. The calculations were carried out for two different partial wave cutoffs ($l \leq 2$ and $l \leq 6$) and in case of ^{56}Fe with and without inclusion of two additional competing neutron decay channels of the compound nucleus. (auth)

26132 STUDY OF SOME ALPHA GROUPS FROM ^{241}Am. Rama Rao, M. (Saha Inst. of Nuclear Physics, Calcutta). Indian J. Phys., 39: 505-10(Nov. 1965).

Alpha decay of ^{241}Am was investigated with a low-pressure expansion cloud chamber. It was possible to measure the energies and relative abundances of at least 5 alpha ray groups. Based on these experimental data a partial level scheme for ^{237}Np is presented and discussed. (auth)

26133 DIRECTIONAL CORRELATION STUDY OF GAMMA CASCADES IN THE DECAY OF ^{124}Sb. Rama Mohan, R. V.; Venkata Reddy, K.; Venkatapathi Raju, B. B.; Jnanananda, Swami (Andhra Univ., Waltair, India). Indian J. Phys., 39: 521-9(Nov. 1965).

The decay scheme of ^{124}Sb is studied and the gamma-gamma directional correlation measurements are carried out for few cascades. On the basis of the experimental data on directional correlations, the spin assignments are made for the 603, 1326, 1964, 2313, 2688 kev excited levels of ^{124}Te. Multipole assignments are made for 989, 1362 kev transitions. (auth)

26134 TABLES OF REDUCED MATRIX ELEMENTS FOR CENTRAL AND TENSOR INTERACTIONS IN NUCLEAR SHELL THEORY. Aggarwal, G.; Bahl, S.; Kumar, N. (Panjab Univ., Chandigarh, India). Indian J. Pure Appl. Phys., 4: 129-30(Mar. 1966).

Reduced off-diagonal and diagonal matrix elements of Gaussian shape for use with central and tensor interactions respectively are given. These data are useful for the analysis of low-lying states of nuclei on the basis of nuclear shell theory. (auth)

26135 INFLUENCE OF STRUCTURE OF THREE-PARTICLE NUCLEI ON THE PHOTODISINTEGRATION CROSS SECTION. Fetisov, V. N. (Lebedev Physics Inst., Moscow). JETP Lett. (USSR) (Engl. Transl.), 3: 108-10(Feb. 15, 1966).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Redakt., 3: 170-3(Feb. 15, 1966).

The cross sections for the photodisintegration of the nuclei ^3He and ^3H were obtained for the reactions $\gamma + {}^3He \rightarrow p + p + n$ and $^3H(^3He)$ (γ,d) n(p), using a Hulthen deuteron function, under the assumption that the ground state of the nucleus is described by the function of Dalitz and Thacker. The cross sections derived approximate the experimental curves more accurately than previous theoretical cross sections. (G.O.Y.)

26136 THE PROTON STRUCTURE AND HYPERFINE SPLITTING OF HYDROGEN ENERGY LEVELS. Faustov, R. N. (Joint Inst. for Nuclear Research, Dubna, USSR). Nucl. Phys., 75: 669-81(Jan. 1966).

The quasipotential approach in quantum field theory is used to calculate the hyperfine structure interval in hydrogen. The quasipotential equation for the system of two fermions is obtained. The corrections of the relative order of $\alpha(m/M)$ to the Fermi formula for the S levels are calculated with the account of the proton electromagnetic form factor. The theoretical and experimental values of the ground state hyperfine structure interval in hydrogen are compared. (auth)

26137 TABLES OF IDENTICAL-PARTICLE FRACTIONAL PARENTAGE COEFFICIENTS. Bayman, B. F.; Lande, Alexander (Princeton Univ., N. J.). Nucl. Phys., 77: 1-80(1966). (PUC-1965-157).

The one-particle fractional parentage coefficients for totally antisymmetric states of n identical fermions calculated by diagonalizing the Casimir operators of the unitary and symplectic groups. They are tabulated for n up to the half-filled shell for $j \leq 11/2$, and $n \leq 5$ for $j = 13/2$ and $15/2$, respectively. The coefficients for totally symmetric states of identical bosons, $d^n (n \leq 7)$, $f^n (n \leq 6)$ and $g^n (n \leq 5)$ were determined in a similar manner. (auth)

26138 DETERMINATION OF THE K FLUORESCENCE YIELD AND THE RATIO OF K X-RAY TO GAMMA-RAY INTENSITY OF ^{113}In USING A SOLID STATE DETECTOR. Sen, S. K.; Durosinmi-Etti, I. O. (Univ. of Manitoba, Winnipeg, Can.). Nukleonika, 8: 127-8(Mar. 1966).

A coincidence technique employing a solid-state detector was used to give the value for K fluorescence yield of

^{113}In. It was independent of x-ray detection efficiency and in fair agreement with results obtained by other methods. (auth)

26139 NUCLEAR SPECTROSCOPY OF THE N = 29 ISOTONES. Pellegrini, F. (Univ., Padua). Nuovo Cimento (10), 43B: 170-82(May 11, 1966).

Energy levels in the N = 29 isotones (^{51}Ti, ^{52}V, ^{53}Cr, ^{54}Mn, ^{55}Fe) arising from the coupling of protons in the $1f_{7/2}$ shell and the single neutron in the $2p_{3/2}$ shell are calculated by the use of effective interactions. The required two-body residual interactions are deduced from the experimental spectra of ^{50}Ti and ^{56}Co. A comparison with available experimental data shows in general good correspondence. However, some low-lying states indicate the mixing of configurations in which the single neutron outside the ^{48}Ca core is in the $2p_{1/2}$ and $1f_{5/2}$ orbits. (auth)

26140 ENERGY SPECTRUM OF PHOTONEUTRONS FROM ^{6}Li. Paoli, G.; Scotto, M.; Wataghin, A. (Univ., Genoa. Istituto Nazionale di Fisica Nucleare, Genoa). Nuovo Cimento (10), 43B: 189-91(May 11, 1966).

Photoneutrons emitted at 90° with respect to a 30-Mev-max bremsstrahlung beam incident on a ^{6}Li target were recorded by the recoil protons in L-4 Ilford nuclear emulsions. Graphs of the neutron energy spectra obtained in two scans are shown, and results of calculating the energy levels of the ^{6}Li excited states from the spectral peaks are given and compared with those of previous studies. (M.J.T.)

26141 NUCLEAR ELECTRIC QUADRUPOLE MOMENT OF ODD-ODD ^{134}Cs. Heinzelmann, G.; Putlitz, G. Zu; Schenck, A. (Univ., Heidelberg). Phys. Lett., 21: 162-4 (May 1, 1966).

The hyperfine structure splitting of the $7\,^2P_{3/2}$ state of ^{134}Cs was investigated with optical double resonance. The results are: Electric quadrupole coupling constant B = 18 (1) Mc/s, electric nuclear quadrupole moment of ^{134}Cs Q = +0.43 (4) barn without and Q = +0.35 (3) barn with Sternheimer correction. (auth)

26142 STARK EFFECT ON ^{39}K HYPERFINE STRUCTURE. Snider, J. L. (Harvard Univ., Cambridge, Mass.). Phys. Lett., 21: 172-3(May 1, 1966).

The Stark shift of the ground state hyperfine transition frequency in ^{39}K was measured. The result is $\delta\nu = -(7.60 \pm 0.76) \times 10^{-8}E^2$ cps, with E in v/cm. This result is in good agreement with a perturbation calculation. (auth)

26143 THE (p,α) REACTION MECHANISM AT 45 Mev. Craig, R. M.; Hird, B.; Kost, C. J.; Li, T. Y. (Univ. of Manitoba, Winnipeg). Phys. Lett., 21: 177-8(May 1, 1966).

A nonresonant increase in the yield of alpha particles at backward angles was observed in the reaction ^{12}C(p,α)^{9}B which does not appear in the reaction ^{19}F(p,α)^{16}O. This is interpreted as a contribution from the direct exchange process, heavy particle stripping. (auth)

26144 ALPHA DECAY OF ^{245}Cm. Friedman, A. M.; Milsted, J. (Argonne National Lab., Ill.). Phys. Lett., 21: 179-80(May 1, 1966).

The alpha spectrum of ^{245}Cm was studied with Au–Si surface barrier detectors. (auth)

26145 E1 TRANSITIONS IN ODD-MASS DEFORMED NUCLEI WITH PARTICLE ROTATION AND VIBRATION COUPLING. Monsonego, G.; Piepenbring, R. (Centre de Recherches Nucleaires, Strasbourg). Phys. Lett., 21: 180-2(May 1, 1966). (In French).

Effects of Coriolis forces on branching ratios and K forbidden E1 transitions in odd-A deformed nuclei are studied. Experimental data cannot be explained by only these effects. But agreement could be obtained if coupling with octupole vibrations is taken into account. (auth)

26146 $\mathscr{U}_3$ SYMMETRY AND CLUSTERING IN THE HARMONIC OSCILLATOR SHELL MODEL. Kramer, P. (Univ., Mexico, Mexico City). Phys. Lett., 21: 182-4 (May 1, 1966).

The unitary symmetry group U_{3A} of A particles in an harmonic oscillator admits the subgroup $\mathscr{U}_3 \times U_A$. Binding energies in the 1p shell are considered in terms of a quadrupole-quadrupole and a clustering interaction related to $\mathscr{U}_3$ and U_A respectively. (auth)

26147 POTENTIAL MODEL FOR ISOBARIC ANALOG STATES. Bondorf, J. P. (Niels Bohr Inst., Copenhagen); Luetken, H.; Jaegare, S. Phys. Lett., 21: 185-7(May 1, 1966).

Isobaric analog states observed as resonances in (pp) scattering are explained by an optical model for which the isovector potential gives a coupling between the low excited target states and their isobaric analog states. The model is exemplified for ^{48}Ca(pp). (auth)

26148 DIFFRACTION MODEL FOR QUASIELASTIC INTERACTIONS. Abul-Magd, A. Y. (Atomic Energy Establishment, Cairo). Phys. Lett., 21: 187-9(May 1, 1966).

Using the adiabatic approximation, the cross section for a quasielastic reaction is expressed in terms of the derivatives of elastic scattering amplitudes. A simple diffraction formula is obtained for the quasielastic interactions of strongly absorbed particles. (auth)

26149 NONLOCAL OPTICAL MODEL CALCULATIONS FOR THE ELASTIC SCATTERING OF PROTONS. Schulz, H.; Wiebicke, H. (Central Inst. for Nuclear Research, Rossendorf, Ger.). Phys. Lett., 21: 190-3(May 1, 1966).

The nonlocal optical potential for elastic scattering, used by Perey and Buck for neutrons, is applied to protons. Differential cross sections and polarization for various elements are calculated in the energy range of 7 to 22 Mev. With nonlocal parameters very similar to those obtained for neutrons the experimental data can be fitted very well. (auth)

26150 BETA DECAY CALCULATIONS WITH KUO'S REALISTIC MATRIX ELEMENTS. Zamick, L. (Princeton Univ., N. J.). Phys. Lett., 21: 194-6(May 1, 1966).

The wave functions of the nuclei ^{14}C and ^{14}N were calculated using shell model matrix elements obtained from the Hamada-Johnston potential. This interaction has a tensor part and fits two nucleon scattering data to several hundred Mev. Provided one is allowed to vary the $p_{1/2}-p_{3/2}$ single particle splitting, one can explain the fact that the β transition rate from ^{14}C to ^{14}N is very nearly zero. A $p_{1/2}-p_{3/2}$ splitting of 9.2 Mev is required as compared with the experimental value of 6.3 Mev. With the central Kallio-Kolltveit interaction, it is not possible to get a vanishing transition rate, no matter what value of the spin-orbit splitting is chosen. The Hamada-Johnston interaction leads to a very reasonable result for the very fast transition ^{18}Ne → ^{18}F – log ft = 2.92 as compared with the experimental value 3.05. (auth)

26151 ISOBARIC ANALOG OF THE ^{121}Sn GROUND-STATE TRIPLET. Allan, D. L.; Jones, G. A.; Taylor, R. B.; Weinberg, R. B.; (Atomic Energy Research Establishment, Harwell, Eng.). Phys. Lett., 21: 197-8(May 1, 1966).

The isobaric analogs of the ^{121}Sn ground state triplet were investigated by elastic and inelastic proton scattering. The data show a $\frac{1}{2}^+$ resonance 70 kev above a $\frac{3}{2}^+$ resonance. Little evidence was seen for the expected $\frac{11}{2}^-$ resonance. (auth)

26152 NUCLEAR PHOTOEFFECT IN TRITIUM. Kosiek, R. (Univ., Heidelberg); Mueller, D.; Pfeiffer, R.; Merwitz, O. Phys. Lett., 21: 199-200(May 1, 1966). (In German).

The nuclear photoeffect in tritium induced by 32.5 Mev bremsstrahlung was investigated. Energy spectra of protons and deuterons from the reactions ^{3}T(γ,p)2n and ^{3}T(γ,n)d were separately recorded by a dE/dx-E-semiconductor telescope. The cross section of the reaction ^{3}T(γ,n)d is given for γ energies E_γ = 17 to 31 Mev. (auth)

26153 EFFECTIVE INTERACTION FOR 1P SHELL NUCLEI CALCULATED FROM THE HAMADA-JOHNSTON POTENTIAL. Becker, R. L. (Oak Ridge National Lab., Tenn.); MacKellar, A. D. Phys. Lett., 21: 201-4(May 1, 1966). (ORNL-P-2110).

Reaction matrix elements with respect to harmonic oscillator orbitals for use in shell model calculations of the spectra of the 1p shell nuclei were calculated in the

extended Eden-Emery approximation employing the Hamada-Johnston potential. (auth)

26154 ANOMALOUS SHAPE OF THE 1776-kev $0^- \rightarrow 2^+$ β TRANSITION IN THE DECAY OF 27-hr ^{166}Ho. Beekhuis, H. (Rijksuniversiteit, Groningen, Netherlands). Phys. Lett., 21: 205-6(May 1, 1966).

The shape of the $0^- \rightarrow 2^+$ beta transition in the decay of ^{166}Ho is found to be represented by $C(W) = \{1 - (0.105 \pm 0.010)W\}(q^2 + \lambda_2 p^2)$. (auth)

26155 TWO MINIMA IN THE CONFIGURATION $(11/2)^6$. Sips, L. (Niels Bohr Inst., Copenhagen). Phys. Lett., 21: 206-9(May 1, 1966).

The configuration $(11/2)^6$ with Q-Q interaction was solved exactly. Two inherent minima of the opposite type of deformation predict two degenerate rotational bands. The degeneracy is removed and the coupling appears to be associated with the variation of the system in the γ-plane. Implications are discussed. (auth)

26156 GENERALIZED HARTREE-FOCK CALCULATION WITH AN EFFECTIVE INTERACTION FOR FINITE NUCLEI. Shakin, C. M.; Svenne, J.; Waghmare, Y. R. (Massachusetts Inst. of Tech., Cambridge). Contract AT(30-1)-2098. Phys. Lett., 21: 209-10(May 1, 1966). (MIT-2098-232).

Results are reported for generalized Hartree-Fock calculations on ^{16}O using the Yale potential. Positions of single particle orbits, binding energy and r.m.s. radii are given. The results are compared with those of other authors and the experimental data. (auth)

26157 ANALYSIS OF ELASTIC AND INELASTIC NUCLEAR SCATTERING. Potgieter, J. M.; Frahn, W. E. (Univ. of Cape Town). Phys. Lett., 21: 211-13(May 1, 1966).

Differential cross sections for elastic and inelastic scattering of composite particles by nuclei, including single and double excitation, are given in closed form. As an example, the scattering of 50.9 Mev alpha particles by ^{40}Ca is analyzed. (auth)

26158 ISOMER SHIFTS RATIOS IN ^{151}Eu AND ^{153}Eu. Steichele, E.; Huefner, S.; Kienle, P. (Technische Hochschule, Darmstadt, Ger.). Phys. Lett., 21: 220-2 (May 1, 1966).

Isomer shifts of the 21.7- and 103-kev γ lines in identical absorber materials of Eu-metal, EuO, EuB_6, and $EuSO_4$ were measured relative to Eu_2O_3 at 4.2°K. The results are used to test the validity of the relation given in first-order perturbation theory. (L.B.S.)

25159 ALPHA-PARTICLE MODELS FOR ^{28}Si AND ^{32}S. Nordstrom, Dennis L.; Tunheim, Jerald A.; Duffey, George H. (South Dakota State Univ., Brookings). Phys. Rev., 145: 727-32(May 20, 1966).

Energy levels of ^{28}Si and ^{32}S were correlated with predictions of alpha-particle models belonging to various point groups. For ^{28}Si best results were obtained with the alpha particles arranged in two tetrahedra sharing a common vertex and having either D_{3h} or D_{3d} symmetry. For ^{32}S the most suitable structures consist of two tetrahedra placed base to base with D_{3h} or D_{3d} symmetry. The tetrahedra are not regular, however. (auth)

26160 PROPERTIES OF A THREE-NUCLEON BOUND-STATE WAVE FUNCTION. Phillips, A. C. (Univ. of Sussex, Falmer, Eng.). Phys. Rev., 145: 733-6(May 20, 1966).

The bound state of the three-nucleon system is considered, using the Faddeev equations and an approximation scheme that involves the use of nonlocal separable potentials to describe the low-energy nucleon-nucleon interaction, and a phenomenological three-body force to represent the effects on the three-nucleon system of the nucleon-nucleon tensor and short-range interactions. The theoretical results for the dominant S state are in reasonable agreement with the experimental data. An S'-state probability of $(1.9 \pm 1)\%$ is predicted. (auth)

26161 GAMMA RAYS FROM ^{10}B + p; DECAY SCHEMES AND EXCITATION FUNCTIONS. Segel, R. E.; Singh, P. P.; Hanna, S. S.; Grace, M. A. (Argonne National Lab., Ill.). Phys. Rev., 145: 736-45(May 20, 1966).

The formation and decay of all the gamma-ray emitting states produced in bombarding ^{10}B with protons in the energy range $4 \leq E_p \leq 12$ Mev were studied. Re-examination of the gamma-ray decay scheme of ^{10}B showed no evidence for the existence of either a 1.74- or a 1.84-Mev transition; the value $\Gamma_\gamma/\Gamma_\gamma = 0.73 \pm 0.15$ was obtained for the alpha-unstable 5.16-Mev level. Gamma rays from the first excited states of ^{7}Be and ^{10}C were also observed; the energy of the latter was determined to be 3.35 ± 0.01 Mev. The formation of the positron-emitting ground state of ^{10}C was studied by means of the annihilation radiation. Giant-resonance structures in the region $12 \leq E_x\ ^{11}C \leq 18$ Mev were observed in the yield curves for all reactions that did not leave the final nucleus in a T = 1 state. A strong correlation between maximum cross sections and reaction energies is noted, but this correlation in itself does not appear to be sufficient to explain the marked suppression of the T = 1 final states. It is shown that a resonance in the four-particle system $\alpha + \alpha + d + p$ could be responsible for the giant-resonance structures. (auth)

26162 NUCLEAR MATRIX ELEMENTS OF SECOND-FORBIDDEN BETA TRANSITIONS AND THE j-j COUPLING MODEL. Lipnik, P. (Centre de Physique Nucleaire, Louvain, Belg.); Sunier, J. W. Contract Nonr-233(44). Phys. Rev., 145: 746-54(May 20, 1966).

The ratios of nuclear matrix elements compatible with the experimental shape factors of the second-forbidden beta transitions in the decay of ^{36}Cl, ^{59}Fe, ^{99}Tc, ^{129}I, ^{135}Cs, and ^{137}Cs are computed. In each case a solution is found which agrees with the predictions $\int iA_{ij}/\int R_{ij}$ of the conserved vector current theory and is close to the extreme single-particle estimate of $\int iT_{ij}/\int R_{ij}$. Deviations are analyzed by introducing small amounts of configuration mixing. The standard matrix elements $\int R_{ij}/R^2$ are computed and compared to their single-particle estimate. (auth)

26163 NUCLEAR RECOIL IN THE ^{12}C(p,pn)^{11}C REACTION. I. ANGULAR DISTRIBUTION. Panontin, J. A.; Schwartz, L. L.; Stehney, A. F.; Steinberg, E. P.; Winsberg, L. (Argonne National Lab., Ill.). Phys. Rev., 145: 754-7(May 20, 1966).

The angular distribution of the recoiling ^{11}C atoms from the reaction ^{12}C(p,pn)^{11}C, induced by 450-Mev protons, was measured. The results were compared with the theoretical calculations of Benioff and Person. The distorted-wave impulse approximation gives better agreement than does the plane-wave approximation. However, the theoretical values from both calculations appear to be too large at the backward angles. This may indicate the existence of competing mechanisms. The results reported here are in general agreement with the thick-target thick-catcher recoil measurements of Singh and Alexander. A similar comparison for the reaction ^{65}Cu(p,pn)^{64}Cu indicates no agreement between the two types of experiment. (auth)

26164 ACCURACY OF COULOMB STRIPPING FOR MEASURING SINGLE-PARTICLE REDUCED WIDTHS IN NUCLEI. Gibson, Faison P. (Oak Ridge National Lab., Tenn.); Kerman, Arthur K. Phys. Rev., 145: 758-65 (May 20, 1966). (ORNL-P-1667).

A finite-range n-p potential and the effect of deuteron stretch were introduced into a distorted-wave Born-approximation (DWBA) analysis of the d-p stripping process for the case in which both deuteron and proton have energies below the Coulomb barrier. This energy region was chosen because it permits an estimate of the experimental reduced width, which does not depend significantly on assumptions regarding the target interior. The stretch of the deuteron wave function is calculated with the adiabatic approximation under the electric dipole perturbation of the target. The proton and neutron wave functions are Taylor-expanded about the center-of-mass coordinate of the deuteron as a series in the relative coordinate of the deuteron. The stripping matrix element is then expressed to second order in this parameter as a

sum of five terms, which are introduced into a modified version of the Gibbs-Tobocman DWBA stripping program. A series of calculations was made for the case of a Bi target in order to compare these second-order terms with the first-order term, which is just the usual zero-range approximation. The shape of the proton angular distribution was only modestly affected. The change in peak magnitude varied up to about 16% in the Coulomb-stripping region, with corresponding inverse effect on the experimental reduced widths that would be inferred therefrom. The effect of the nuclear potentials producing proton and deuteron elastic scattering is significant, but it is mostly contained in the region of the integrations and therefore depends mainly on the elastic-scattering phase shifts. It is concluded that the particle reduced widths can be "measured" by Coulomb stripping to better than 10% as far as theoretical uncertainties are concerned. (auth)

26165 GIANT DIPOLE RESONANCES IN THE s-d SHELL AND THEIR ELECTROMAGNETIC PROPERTIES. Bassichis, W. H.; Scheck, F. (Weizmann Inst. of Science, Rehovoth, Israel). Phys. Rev., 145: 771-8(May 20, 1966).

The Hartree-Fock self-consistent-field calculations of the single-particle orbitals in ^{20}Ne, ^{24}Mg, and ^{28}Si including, besides the (2s,1d) shell, the (1p) and the (2p,1f) shells, is performed. Using these single-particle energies and wave functions calculations are made of the giant dipole resonances within the framework of the particle-hole model and their electromagnetic properties such as oscillator strengths, γ widths, and cross sections for the inelastic scattering of high-energy electrons. For the interaction (for both the Hartree-Fock treatment and the particle-hole calculation) a standard Rosenfeld force was chosen, which fits low-energy data in the s-d shell. In ^{24}Mg and ^{28}Si the resulting giant-resonance states form essentially two groups: The first, with lower energies, is built mainly out of particle-hole transitions from the (2s,1d) to the (2p,1f) shell; the second one is built mainly out of $(1p)^{-1}$ (2s,1d) states. This result is in agreement with experimental studies of (p,γ), (γ,p), and (p,n) reactions in these nuclei. For the fine structure within each group, however, the agreement with the experimental data is poorer. This however is not surprising in view of the lack of knowledge about the radial shape of the wave functions, the proper form of the interaction, etc. It turns out, moreover, that the lower group contains mainly K = 0 states whereas in the higher group the K = 1 states are dominant. This splitting between K = 0 and K = 1 states is expected from the collective model and from the experimental situation in the strongly deformed nuclei of the rare-earth and the transuranium group. (auth)

26166 ABSORPTION OF STOPPED π^- MESONS BY ^{3}He AND NUCLEAR CORRELATIONS. Cheon, Il-Tong (Kyoto Univ.). Phys. Rev., 145: 794-801(May 20, 1966).

The capture rates of stopped π^- mesons by ^{3}He leading to the final states (p + 2n) and (d + n) are calculated by using the two-nucleon-capture model. The ratios of one-nucleon ejection to two-nucleon ejection and the branching ratio W(pn → nn)/W(pp → np) are obtained. Furthermore, the effects of the short-range nuclear correlations on these values are investigated. It is shown that the correlation parameter can be determined from the relative momentum distributions of two ejected nucleons. (auth)

26167 ANGULAR DISTRIBUTIONS AND TOTAL CROSS SECTIONS OF REACTIONS OF ^{6}Li, ^{7}Li, ON ^{10}B, ^{11}B. McGrath, Robert L. (Univ. of Iowa, Iowa City). Phys. Rev., 145: 802-30(May 20, 1966).

Charged particles from four sets of reactions induced by ^{6}Li, ^{7}Li on ^{10}B, ^{11}B targets were observed. The incident beam energy in each case corresponds to 3.05 Mev in the center-of-mass system. A dE/dx, E counter coupled to an on-line computer is used to obtain 115 angular distributions and absolute cross sections of p, d, t, ^{3}He, and ^{4}He particles. ^{14}N, ^{15}N, ^{16}N, and ^{13}C are formed in several different reactions. The observed relative cross sections are often independent of the mode of formation. Cross sections for low-lying states of these nuclei, and ^{12}C, ^{14}C are closely proportional to (2J + 1) where J is the spin of the residual state. On this basis it is suggested that the statistical compound nucleus mechanism dominates the cross sections to many low-lying states. At high-level excitations, yields typically deviate upwards from (2J + 1) dependence. The ^{15}N 9.16-Mev and ^{14}N 9.13-, 10.09-, and 11.06-Mev states have very large yields in the (^{6}Li,d), (^{7}Li,t) reactions. At these higher excitations direct reactions evidently supplement the statistical yields. Unambiguous evidence for the following unreported levels is found: 7.17 ± 0.04, 7.37, 8.14, 8.55, 8.93, 9.26, and 9.74 Mev in ^{17}N; 7.66 ± 0.05, 8.10, 8.36, 8.83, and 9.47 Mev in ^{16}N; and 10.79 ± 0.03 Mev in ^{14}N (previously reported as 10.71 ± 0.09 Mev). (auth)

26168 GENERALIZED SENIORITY AND THE SURFACE DELTA INTERACTION. Arvieu, R.; Moszkowski, S. A. (Univ. of California, Los Angeles). Phys. Rev., 145: 830-7(May 20, 1966).

It is shown that the surface delta interaction (SDI), which can be defined as a delta interaction $\delta(\Omega_{12})$ in the angles of the interacting particles (with the additional assumption that all radial integrals are equal), provides a very simple coupling scheme for configuration of identical particles (i.e., maximum isospin) involving degenerate mixed orbits. This scheme, a generalization of the well-known seniority scheme, can be conveniently expressed in terms of "quasi-spin." It is shown that the SDI is a sum of a term which is a scalar with respect to quasispins and a term which is proportional to the number of particles. The well-known pairing interaction, like the SDI, is diagonal with respect to quasispin but is not a quasispin scalar. Thus for configurations of an even number of identical particles in mixed degenerate orbits coupled by an SDI, the ground-state energy of the seniority zero ground state varies linearly with the number of particles. The BCS method can also be applied and the excited states are expressed in terms of quasiparticle configurations. For identical nucleons in degenerate orbits coupled by an SDI, the exact energies of the ground-state and low-lying levels are obtained. (auth)

26169 SURFACE DELTA INTERACTION AND SINGLE-CLOSED-SHELL NUCLEI. Plastino, A.; Arvieu, R.; Moszkowski, S. A. (Univ. of California, Los Angeles). Phys. Rev., 145: 837-51(May 20, 1966).

The surface delta interaction was applied in a calculation of the energy levels of isotopes of Pb, Sn and Ni, ^{210}Po, and nuclei belonging to the 82-neutron shell. The Bogoliubov-Valatin method combined with the Tamm-Dancoff approximation was utilized. In certain cases, exact shell-model calculations were also performed. The comparison between the results obtained in these two ways shows that the approximation method works quite well for the two-particle case. For more than two particles outside closed shells, the approximation works relatively well only for the 2_1+ and 4_1+ states. The agreement with experiment is fairly good in general. For ^{206}Pb the results are even slightly better than those of True and Ford. For ^{204}Pb and ^{202}Pb it was found necessary to reduce the strength of the interaction about 10%. In Ni and in the 82-neutron nuclei the results are fairly good, but in the isotopes of Sn and in ^{210}Pb the 2+ and 4+ states lie somewhat too high. (auth)

26170 STUDIES OF ELASTIC SCATTERING OF PROTONS AND DEUTERONS BY CALCIUM ISOTOPES. Marinov, A.; Lee, L. L. Jr.; Schiffer, J. P. (Argonne National Lab., Ill.). Phys. Rev., 145: 852-61(May 20, 1966).

Angular distributions of elastically scattered protons and deuterons from enriched isotopic targets of ^{42}Ca, ^{44}Ca, and ^{48}Ca were measured at bombarding energies of 9 and 12 Mev, between 30 and 168°. The data are analyzed in terms of the optical model, with particular emphasis on the importance of a symmetry term in the proton potential. The energy dependence of the parameters is also discussed. The results are compared with those obtained from earlier work on isotopes of nickel and copper. An attempt is made to find systematic trends in the deuteron potential and a comparison is made with earlier measurements of deuteron scattering from ^{40}Ca and from Ni and Cu isotopes. (auth)

26171 NUCLEAR RESONANCE FLUORESCENCE IN ^{82}Kr. Beard, G. B. (Argonne National Lab., Ill. Wayne State Univ., Detroit). Phys. Rev., 145: 862-5(May 20, 1966).

The 777-kev excited state of ^{82}Kr was investigated by means of nuclear resonance-fluorescence scattering experiments. The level width was found to be $(9.6 \pm 1.5) \times 10^{-5}$ ev, corresponding to a mean life of $(6.9 \pm 1.1) \times 10^{-12}$ sec. From this result and the relative reduced transition probabilities determined previously by Heydenberg, Pieper, and Anderson, the mean lives for first excited states of other even-even Kr isotopes can be obtained. No resonant scattering from the 1.475-Mev state of ^{82}Kr was observed and its mean life was estimated to be $>1.2 \times 10^{-12}$ sec. (auth)

26172 ANGULAR-CORRELATION MEASUREMENTS AND THE ^{30}Si(p,γ)^{31}P REACTION. Harris, Gale I.; Breitenbecher, D. V. (Aerospace Research Labs., Wright-Patterson Air Force Base, Ohio). Phys. Rev., 145: 866-87(May 20, 1966).

Gamma-ray angular-distribution and triple-correlation measurements were performed at the E_p = 1095-, 1204-, and 1322-kev resonances in the ^{30}Si(p,γ)^{31}P reaction, which provide new information on properties of the E_x = 3.29-, 3.51-, 4.26-, and 4.63-Mev levels of ^{31}P. The angular-correlation data were analyzed with newly developed search programs that utilize the substate population representation and a recently introduced factored form of the correlation functions that is applicable to multiple cascades. The previous assignments 3.29 ($\frac{5}{2}$), 3.51 ($\frac{5}{2}$), and 4.26 ($\frac{3}{2}$) are confirmed, and $J = \frac{3}{2}$ is assigned to the 4.63-Mev level. The 3.29-Mev level decays in the ratio 77 : 23 to the 1.27- and 2.23-Mev levels. No evidence is found for the previously reported 3.29 → 0 transition. The quadrupole-dipole amplitude ratios (δ) for the 3.29 → 1.27 and 3.29 → 2.23 transitions are -0.44 ± 0.02 and -0.41 ± 0.06, respectively. The value of δ for the 3.51 → 0 transition is -0.41 ± 0.03 or 7.1 ± 1.0. The 3.51-Mev level was also found to decay to both the first- and second-excited states and unambiguous values for the mixing ratios were obtained. The 4.26-Mev level was found to decay in the ratio 76 : 20 : 4 to the ground, first-excited, and second-excited states. The 4.63-Mev level was found to decay in the ratio 27 : 52 : 21 to the same states. A new decay scheme is proposed for the E_p = 1095-kev resonance which proved to be more complex than had been previously reported. The values of δ obtained for the 4.26 → 0, 4.26 → 1.27, 4.63 → 0, and 4.63 → 1.27 transitions are -0.32 ± 0.04 or 4.7 ± 0.9, -0.25 ± 0.05, 0.07 ± 0.04 or 1.48 ± 0.12, and -0.02 ± 0.05 or -3.9 ± 1.0, respectively. All the ambiguities in δ, except for the last one, are due to inherent limitations in the intensity-direction correlation method. The extended version of the triple-correlation formulation for multiple cascades was found to be very useful in some of the more complex situations encountered in this work. A brief review of recent model calculations which relate to properties of states in ^{31}P is given. On the basis of comparison of results of available calculations, it appears that the weak-coupling unified models receive the most support from the existing data. (auth)

26173 ELASTIC AND INELASTIC SCATTERING OF 9.8-Mev DEUTERONS FROM ^{31}P. Lucas, B. T.; Johnson, O. E. (Purdue Univ., Lafayette, Ind.). Phys. Rev., 145: 887-93(May 20, 1966). (COO-1420-121).

The 9.8-Mev differential cross sections for deuteron scattering reactions that leave ^{31}P in its ground and lowest three excited states (1.265, 2.232, and 3.133 Mev) were measured. The targets were produced by the vacuum evaporation of red phosphorus (~625 μg/cm^2) onto thin Formvar films (2–5 μg/cm^2). The spectra were measured using an electronic mass-discriminating spectrometer system which incorporated an (E,ΔE) counter telescope consisting of two silicon surface-barrier detectors. The (σ_E/σ_R) ratio for the elastic scattering exhibits a somewhat irregular oscillatory structure forward of 100°. The d_1 and d_2 angular distributions are remarkably similar in shape and are clearly in phase, but there is no definite phase relationship between them and the d_0 angular distribution. The d_3 angular distribution is roughly out of phase with the d_1 and d_2 angular distributions. The integrated cross sections for the excitation of the first, second, and third excited states are 3.51 ± 0.04 mb (26.7°–170.7°), 6.74 ± 0.04 mb (26.8°–170.7°), and 0.77 ± 0.02 mb (32.3°–170.8°), respectively. The elastic-scattering cross section was analyzed in terms of the nuclear optical model with a four-parameter Saxon potential. Three distinct sets of parameters were found, which give moderately good fits to the experimental data for angles less than 150°. The ambiguities in the optical-model parameters encountered in the fitting procedure are described and discussed. The d_1 and d_2 cross sections were analyzed in terms of the distorted-wave theory using a simple collective-model description for the excited states of ^{31}P and the optical-model parameters determined through the analysis of the elastic-scattering data. The resulting calculated cross sections reproduce the general features of the data over a rather wide angular range, the most serious discrepancies occurring at forward angles. The implications of these analyses and the present experimental results are discussed in terms of existing collective-model descriptions of this nucleus. (auth)

26174 ISOBARIC-ANALOG STATES IN ^{49}Sc. Jones, K. W. (Brookhaven National Lab., Upton, N. Y.); Schiffer, J. P.; Lee, L. L. Jr.; Marinov, A.; Lerner, J. L. Phys. Rev., 145: 894-900(May 20, 1966). (BNL-9822).

Cross sections for the elastic scattering of protons by ^{48}Ca were measured at laboratory angles of 90, 120, and 160° for bombarding energies from 1.3 to 7.0 Mev. Prominent anomalies were observed in the excitation curves at c.m. proton energies of 1.935 ± 0.003, 1.945 ± 0.003, 3.86 ± 0.03, 5.952 ± 0.005, and 5.994 ± 0.005 Mev. These anomalies indicate the positions of states in the compound nucleus ^{49}Sc that are isobaric analogs of the ground state and excited states of ^{49}Ca. An analysis of these data and a comparison with the ^{48}Ca(d,p)^{49}Ca results are presented. A value of 7.090 ± 0.006 Mev for the ^{49}Ca–^{49}Sc, Coulomb energy difference is obtained from the observed proton bombarding energy for the ground-state analog. All the known Coulomb energies for the odd Ca and Sc isotopes were analyzed in terms of a simple model using single-particle wave functions in a Woods-Saxon well, and are interpreted in terms of charge radii. (auth)

26175 ALPHA-PARTICLE SCATTERING AND PRODUCTION OF AN UNNATURAL-PARITY STATE IN ^{28}Si. Bingham, Felton W. (Univ. of Illinois, Urbana). Phys. Rev., 145: 901-6(May 20, 1966).

Alpha-particle scattering from ^{28}Si was studied at six bombarding energies between 16.2 and 27.0 Mev. Angular distributions for scattering from the ground and four excited states are presented at each energy, and total cross sections are obtained from these differential cross sections. Because the unnatural-parity excited state at 6.27 Mev cannot be excited by alpha-particle scattering under direct-interaction conditions, special attention was paid to measuring the angular distribution of the cross section for production of this state. The angular distribution itself does not provide any unambiguous indication of the reaction mechanism responsible for production of the 6.27-Mev state; identification of the mechanism will require a full theoretical analysis of these data. (auth)

26176 INVESTIGATION OF HIGHER ORDER EFFECTS IN THE ALLOWED BETA DECAY OF ^{56}Mn. Fischbeck, H. J.; Greenberg, W. M. (Univ. of Michigan, Ann Arbor). Phys. Rev., 145: 907-11(May 20, 1966).

Directional-correlation measurements were performed on the allowed 2.86-Mev β-0.845-Mev γ transition in the decay of ^{56}Mn. The results indicate that a small negative correlation ($A_2 = -0.0030 \pm 0.0011$) exists. For comparison, the β-γ directional correlation was also measured in the allowed β decay of ^{131}I. The distribution was found to be isotropic within the experimental error and the correlation coefficient was found to be $|A_2| < 0.0005$ in this case. The deviation of the ^{56}Mn β spectrum from allowed shape is

discussed and it is shown that a shape factor of the form $C \approx 1 + 0.04W - 0.01/W$ would not be inconsistent with the observed anisotropy. (auth)

26177 FISSION YIELDS OF ^{156}Eu, ^{157}Eu, ^{158}Eu, AND ^{159}Eu. Daniels, W. R.; Hoffman, D. C. (Los Alamos Scientific Lab., N. Mex.). Phys. Rev., 145: 911-14 (May 20, 1966).

The cumulative yields of ^{156}Eu, ^{157}Eu, ^{158}Eu, and ^{159}Eu from thermal-neutron fission of ^{235}U and ≈25-Mev ^{3}He fission of ^{238}U were determined. The thermal yields are: ^{156}Eu, 0.0125 ± 0.0010%; ^{157}Eu, 0.0060 ± 0.0007%; ^{158}Eu, 0.0031 ± 0.0006%; ^{159}Eu, 0.0011 ± 0.0003%. The ^{3}He yields are: ^{156}Eu, 0.27 ± 0.07%; ^{157}Eu, 0.13 ± 0.02%; ^{158}Eu, 0.089 ± 0.015%; ^{159}Eu, 0.057 ± 0.010%. (auth)

26178 MOESSBAUER-EFFECT STUDIES OF THE 97-kev LEVEL OF ^{153}Eu. Atzmony, U.; Ofer, S. (Hebrew Univ., Jerusalem, Israel). Phys. Rev., 145: 915-17 (May 20, 1966).

The recoilless absorption spectra of the 97-kev γ rays from ^{153m}Eu in ^{153}Eu situated in Eu_2O_3, in $EuSO_4$, and in europium iron garnet (EuIG) were measured at 20°K. The source used was ^{153}Gd in the form of an oxide at 20°K. With the Eu_2O_3 and $EuSO_4$ absorbers, unsplit absorption lines were obtained. From their widths, a value of $(2.14 \pm 0.2) \times 10^{-10}$ sec was deduced for the half life of the 97-kev level. Two alternative values for the magnetic moment of the 97-kev level of ^{153}Eu, (+3.21 ± 0.22) nm and (−0.52 ± 0.22) nm, fitted the broadened absorption line obtained with the EuIG absorber. One of the values, (+3.21 ± 0.22) nm, is in agreement with the predictions of the unified model. (auth)

26179 SPECTROSCOPY OF ^{145}Sm VIA (d,p) REACTIONS. Jolly, R. K.; Moore, C. F. (Florida State Univ., Tallahassee. Univ. of Pittsburgh, Pa.). Phys. Rev. 145: 918-25(May 20, 1966).

States of ^{145}Sm were investigated via 15-Mev−deuteron-induced (d,p) reactions with an energy resolution of ~40 kev. The angular-distribution data were analyzed using zero-range distorted-wave Born-approximation calculations to extract spectroscopic information. The proton spectra do not show the simple structure that one would expect from the conventional shell model for an 82-neutron target nucleus. Spin and parity assignments for most of the observed levels together with single-particle energies are presented. (auth)

26180 EFFECT OF BACKSCATTERING ON THE HELICITY OF β RADIATION. Braicovich, L.; De Michelis, B.; Fasana, A. (Istituto di Fisica del Politecnico, Milan). Phys. Rev., 145: 952-6(May 20, 1966).

Experimental investigation was carried out on the dependence on the energy of the average longitudinal polarization of β particles of ^{90}Sr + ^{90}Y, backscattered by a lead target. The ratio of the polarization of backscattered to incident electrons was obtained in the energy ranges 0.3−0.8, 0.55−1.2, and 0.75−2.0 Mev with respective results of 0.657 ± 0.192, 0.503 ± 0.284, 0.650 ± 0.369. The effect of a perturbing magnetic field on helicity was also studied. The results are discussed with reference to the mechanism of the backscattering process. (auth)

26181 PROTON REACTION CROSS SECTIONS AND STRENGTH FUNCTIONS. Elwyn, A. J.; Marinov, A.; Schiffer, J. P. (Argonne National Lab., Ill.). Phys. Rev., 145: 957-62(May 20, 1966).

The average yields of neutrons from proton-induced reactions in thick targets were measured for about 33 elements in the mass region $90 \lesssim A \leq 209$ at incident proton energies between 5.5 and 9.5 Mev. In this region of energies and masses, the (p,n) reaction overwhelms competing reactions so that, except in a few cases, the average (p,n) cross sections deduced from the measured yields are equal to the total reaction cross sections for protons. Reduced cross sections, which are directly related to the proton strength function, were obtained from the measurements. These results, as well as the results of previous measurements for $A < 90$, were compared with optical-model calculations. Proton reaction cross sections calculated from the optical potential of Perey are in remarkably good quantitative agreement with the measurements. The data were consistent with a resonance in the P-wave proton strength function at $A \approx 105$, and with dominant contributions from S- and D-wave protons at $A \approx 65$ and for $155 \leq A \leq 200$. The measured angular distributions for some of the nuclei showed symmetry about 90° to about 2%, indicating no measurable direct-interaction component. The maximum anisotropy observed was about 7%. (auth)

26182 HALF-LIVES AND YIELDS OF X RAYS FROM THERMAL FISSION OF ^{235}U AND ^{239}Pu. Bridwell, Lynn; Wyman, Marvin E.; Wehring, Bernard W. (Univ. of Illinois, Urbana). Phys. Rev., 145: 963-8(May 20, 1966).

Time and energy characteristics of x rays from fission fragments of thermally fissioned ^{235}U and ^{239}Pu were investigated. The timing data were obtained electronically using amplitude-conversion techniques while the energy spectra were obtained using TaI(Tl) as the detector. The timing measurements show that about 50% of the x rays have half lives greater than 4 nsec. This suggests that the dominant or even the entire mechanism for x-ray production is internal conversion of low-energy transitions of the fission fragments. Half lives obtained from a least-squares fit of the time spectra indicate that the transitions are of the type E2 and M1. A model for predicting the x-ray energy spectra is given. X-ray yields calculated from the energy spectra were determined to be 0.17 ± 0.02 and 0.43 ± 0.004 x rays per fission for the light- and heavy-group fragments of ^{235}U, and 0.15 ± 0.02 and 0.26 ± 0.03 x rays per fission for light- and heavy-group fragments of ^{239}Pu. Results from other experimenters are given for comparison. (auth)

26183 LIFETIME OF THE 462-kev LEVEL IN ^{125}Te. Metzger, F. R.; Raghavan, R. S. (Franklin Inst., Swarthmore, Pa.). Phys. Rev., 145: 968-71(May 20, 1966). (NYO-3525-5).

Resonance scattering from ^{125}Te was investigated with ^{125}Sb as the source of the exciting gamma radiation. The centrifuge technique was used for the compensation of the recoil energy losses. Appreciable resonance scattering was observed only from the 462-kev $5/2^+$ level. With a branching ratio $\Gamma_0/\Gamma = 0.24$, the observed scattering corresponds to a partial width $\Gamma_0 = (8.5 \pm 0.9) \times 10^{-6}$ ev for the 462-kev E2 ground-state transition. The mean life of the 462-kev level is thus $(1.9 \pm 0.3) \times 10^{-11}$ sec. The absence of resonance scattering from ^{125}Te levels reported at 633-, 640-, 652-, and 668-kev excitation energy is consistent with the assignment of spin values $\geq 7/2$ to the first two of these states, an upper limit of 0.03% per ^{125}Sb decay for the intensity of the 652-kev transition, and a lower limit of 10^{-11} sec for the mean life of the 668-kev ground-state transition. (auth)

26184 ISOBARIC ANALOGUE STATES IN HEAVY NUCLEI. III. TIN ISOTOPES. Richard, P.; Moore, C. F.; Becker, J. A.; Fox, J. D. (Florida State Univ., Tallahassee). Phys. Rev., 145: 971-81(May 20, 1966).

Isobaric analog resonances were identified in (p,p) and (p,n) excitation functions on the target isotopes ^{112}Sn, ^{116}Sn, ^{117}Sn, ^{118}Sn, ^{119}Sn, ^{120}Sn, ^{122}Sn, and ^{124}Sn. All the resonances observed on the even isotopes were analyzed using a Coulomb-plus-single-level formula. Level separations, l-value determinations, spreading widths, spectroscopic factors, and Coulomb displacement energies are discussed. The spectroscopic information from (d,p) on the same targets are compared to the analog results. (auth)

26185 GROUND-STATE TRANSITION WIDTH OF THE 7.297-Mev LEVEL IN ^{208}Pb. Dowdy, E. J.; McIntyre, J. A. (Texas A and M Univ., College Station, Tex.). Phys. Rev., 145: 982-7(May 20, 1966).

A beam of 7.297-Mev gamma rays, with an energy spread of 3.7 kev, was produced by utilizing the 10.834 → 7.301 → 0 Mev gamma-ray cascade in the ^{14}N(n,γ)^{15}N reaction. The random nuclear-recoil direction produced by the first gamma ray introduced the 3.7-kev energy spread in the second gamma ray through the recoil velocity of the ^{15}N

nucleus. This recoil-broadened beam was used to excite an energy level in lead. The angular distribution of the resonance-scattered radiation was measured and found to fit the $(1 + \cos^2\theta)$ distribution of a dipole transition. From a comparison of the resonance scattering yields from lead and radio-lead, it was concluded that the level excited is a level of ^{208}Pb. The ground-state radiative transition width of the level was measured by means of a resonance self-absorption experiment and found to be $\Gamma_0 = 1.30 \pm 0.25$ ev, assuming that the level decays only to the ground state. This width is comparable to the 0.8-ev width of a similar level in ^{208}Pb at 7.277 Mev. (auth)

26186 LEVELS OF ^{85}Sr POPULATED IN THE DECAY OF ^{85}Y AND ^{85m}Y. Horen, D. J. (Naval Radiological Defense Lab., San Francisco); Kelly, W. H. Phys. Rev., 145: 988-98(May 20, 1966).

Evidence is presented for the existence of two isomers in ^{85}Y with half lives of 2.9 ± 0.2-h and 4.7 ± 0.2-h. Positron, photon, and x-ray measurements, both singles and coincidence, were performed. No evidence was obtained for the existence of an isomeric transition between the two isomers. (auth)

26187 NUCLEAR POLARIZATION OF NEGATIVE DEUTERIUM IONS PRODUCED BY CHARGE EXCHANGE. Drake, C. W.; Krotkov, R. (Yale Univ., New Haven). Phys. Rev. Lett., 16: 848-50(May 9, 1966).

Measurements are reported of the tensor polarization of deuterons in D^- ions made by charge exchange in cesium vapor and converted to negative ions in an argon gas cell. (B.G.D.)

26188 TRANSITION RATES IN ^{10}B AND THE β DECAY OF ^{10}C. Fisher, T. R.; Hanna, S. S.; Paul, P. (Stanford Univ., Calif.). Phys. Rev. Lett., 16: 850-3 (May 9, 1966).

The transition between the 1.74- and 0.72-Mev levels of ^{10}B is the gamma ray analog of the beta transition from ^{10}C to the lower level. A comparison of the relevant matrix elements shows that the measured gamma ray lifetime of $(1.52 \pm 0.24) \times 10^{-13}$ sec cannot be reconciled with the ft value of 1000 for the ^{10}C beta decay, unless there is a serious breakdown of isobaric-spin conservation. The lifetimes of the three levels of ^{10}B (1.74, 2.15, and 3.59 Mev) are remeasured with the Doppler-shift-attenuation method using a Ge (Li) detector. (B.G.D.)

26189 DEUTERON REDUCED WIDTHS ON SUPERFLUID MODEL WITH BARDEEN-COOPER-SCHRIEFFER AND PROJECTED BARDEEN-COOPER-SCHRIEFFER WAVE FUNCTIONS. Dumitrescu, Ovidiu (Bucharest Univ.). Rev. Roum. Phys., 11: 39-55(1966).

On the basis of the superfluid model with Bardeen-Cooper-Schrieffer (BCS) and projected BCS wave functions, explicit expressions of the deuteron reduced widths are given. (auth)

26190 FISSION STUDIES ON HEAVY NUCLIDES: MASS YIELD CURVE IN NEUTRON INDUCED FISSION OF ^{232}Th, ^{237}Np, ^{231}Pa AND ^{227}Ac. Agarwal, R. K.; Jain, H. C.; Lall, J. C.; Namboodiri, M. N.; Rajagopalan, M.; Ramaniah, M. V.; Rao, C. L.; Ravindran, N.; Sharma, H. D.; Iyer, R. S. (Atomic Energy Establishment, Trombay, India). pp 1-6 of Proceedings of the Nuclear and Radiation Chemistry Symposium, 1964. Trombay, India, Atomic Energy Establishment, 1965.

Results of radiochemical studies on the mass distribution in the neutron induced fission of ^{227}Ac, ^{231}Pa, and ^{237}Np are presented. All irradiations were carried out at Apsara. Relative yields of several fission products were obtained by a method that involves a comparison of the fission product activities chemically separated from the target under study with those from uranium simultaneously irradiated. ^{235}U thermal neutron fission yields were assumed. Preliminary results indicated that in all cases the mass distributions are predominantly asymmetric. Approximate peak to trough ratios are given. (auth)

26191 CROSS SECTION RATIOS FOR ^{131}Te ISOMERS. Namboodiri, M. N.; Rajagopalan, M.; Ramaniah, M. V. (Atomic Energy Establishment, Trombay, India). pp 7-10 of Proceedings of the Nuclear and Radiation Chemistry Symposium, 1964. Trombay, India, Atomic Energy Establishment, 1965.

The ratio of cross sections for the production of ^{131g}Te and ^{131m}Te in the ^{130}Te(n,γ) reaction was determined by a radiochemical method involving the separation of ^{131}I from the irradiated tellurium. The large difference in the half lives (^{131g}Te = 25 min, and ^{131m}Te = 30 hr) is taken advantage of to measure the ^{131m}Te and the total ^{131}Te activities separately. The ratio of σ_g/σ_m comes to 16 ± 3. (auth)

26192 SEARCH FOR AN ISOMER OF ^{199}Au. Gopinathan, K. P. (Tata Inst. of Fundamental Research, Bombay). pp 205-7 of Proceedings of the Nuclear and Radiation Chemistry Symposium, 1964. Trombay, India, Atomic Energy Establishment, 1965.

A search was made for an expected isomer in ^{199}Au with a half life of ~30 sec. Pure platinum was irradiated in a reactor. Gold was milked from the dissolved platinum by the bromide extraction method. Gamma spectra of the milked samples were studied using a scintillation spectrometer with a 512-channel analyzer. In comparison with the well known 7-sec ^{197m}Au, an upper limit for the half life of the isomer in ^{199}Au could be one second. (auth)

26193 NUCLEAR HYPERFINE STRUCTURE AND THE SOLID STATE AND CHEMICAL APPLICATIONS OF THE MOESSBAUER EFFECT. Wertheim, G. K. (Bell Telephone Labs., Murray Hill, N. J.). pp 1-17 of STI-DOC-10/50.

The theoretical bases for the use of the Mössbauer effect in studies of hyperfine structure are outlined. The isomer shift, quadrupole coupling, and magnetic dipole coupling are discussed. (D.C.W.)

26194 MOESSBAUER SCATTERING. Debrunner, P.; Frauenfelder, H. (Univ. of Illinois, Urbana). pp 58-73 of STI-DOC-10/50.

The conditions under which a scattering experiment is feasible are discussed, and an upper limit for the effect-to-background ratio is derived for scattering and transmission geometries. An experimental arrangement that was developed for the observation of Mössbauer transitions with small recoilless fractions is described. The analysis of scattering data is outlined, and some typical results are summarized. (D.C.W.)

26195 ISOMER SHIFT OF THE 81-kev GAMMA LINE OF ^{133}Cs. Henning, W.; Huefner, S.; Kienle, P.; Quitman, D.; Steichele, E. (Technische Hochschule, Darmstadt, Ger.). pp 200-5 of STI-DOC-10/50.

The results of an investigation of the Mössbauer effect of the 81-kev transition in ^{133}Cs are summarized. The isomer shifts in a number of cesium compounds are given. (D.C.W.)

26196 UNCONVENTIONAL MOESSBAUER STUDIES. Atac, M.; Frauenfelder, H.; Garrell, M. (Univ. of Illinois, Urbana). pp 213-22 of STI-DOC-10/50.

The use of scattering geometry to study gamma rays with energies greater than about 90 kev; the direct excitation of Mössbauer transitions by neutron capture, Coulomb excitation, or charged-particle reactions; the discovery of very narrow resonances; and measurements involving a short-lived parent nucleus or a radioactive ground state are discussed. Studies involving ^{129}I, ^{61}Ni, ^{186}Os, ^{188}Os, ^{40}K, and ^{181}Ta are considered as examples. (D.C.W.)

26197 RECOILLESS GAMMA-EMISSION FROM EXCITED ATOMIC STATES IN EUROPIUM. Steichele, E.; Henning, W.; Huefner, S.; Kienle, P. (Technische Hochschule, Darmstadt, Ger.). pp 233-6 of STI-DOC-10/50.

An investigation of the recoilless emission spectrum from the 97-kev state of ^{153}Eu after electron-capture decay of ^{153}Gd is summarized. Evidence of recoilless gamma emission from excited states of trivalent Eu was observed. (D.C.W.)

26198 NUCLEAR SHELL MODEL THEORY. I. SINGLE PARTICLE MODEL. Iosifescu, M. Stud. Cercet. Fiz., 16: 657-99(1964).

The nuclear shell model is discussed. The two admitted

types of motion of the nucleons in the nucleus, which generated different models of nucleus are analyzed. Topics covered included the model of nuclear shell, fundamental hypotheses and successive variants; single-particle potential and explanation of magic numbers; identical particles in a common potential; spin-orbit coupling; single-particle levels for the interpolated potential with spin-orbit interaction; and formulation of the single particle model. (Rum. Sci. Abstr.)

26199 NUCLEAR SHELL MODEL THEORY. II. APPLICATIONS OF THE SINGLE PARTICLE MODEL. Iosifescu, M. Stud. Cercet. Fiz., 16: 847-73(1964).

Applications of the single particle model are described. Topics covered include: the first excited states of the magic nuclei, the spins of the ground states of the odd nuclei, the quadrupole electric moments and a comparison between the theoretical results and those experimentally obtained, the magnetic moments, and the isomeric states of the odd nuclei. (Rum. Sci. Abstr.)

26200 ANALYSIS OF CROSS SECTIONS IN PHOTONUCLEAR REACTIONS BY MEANS OF BETATRON-GENERATED BREMSSTRAHLUNG. Baciu, G. Stud. Cercet. Fiz., 16: 903-15(1964).

Studies were made to determine if the existence of an eventual fine structure in the cross sections of medium elements could be attributed to some discrepancies and singularities. For this purpose a measuring device with direct detection of thermal neutrons was used. The absolute yields of the reactions O(γ,n), Ni(γ,n), and Ga(γ,n) were measured, and the results were analyzed by the Penfold-Leiss method for energy intervals of 1 Mev. The characteristic parameter values for the integral cross sections of the reactions $^{16}O(\gamma,n)$ and $^{58}Ni(\gamma,n)$ agreed with those obtained by various authors. The agreement between the data obtained and those of Hartley, at 14.8 Mev, were a confirmation of the validity of the analytical method adopted. (Rum. Sci. Abstr.)

26201 POLARIZATION OF NUCLEONS PRODUCED BY DEUTERON SPALLATION IN ELECTROMAGNETIC NUCLEAR FIELDS. Ismatov, E.; Tartakovskii, V. K. (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR. Kharkov State Univ.). Ukr. Fiz. Zh., 10: 1270-2(1965). (In Russian).

An expression is derived for the polarization of neutrons formed in the deuteron spallation reaction. The proton polarization is similar to the neutron polarization. Numerical calculations are carried out at incident deuteron energies $E_0 = 100$ Mev with an angle $\theta = 18°$ between the deuteron and neutron. The polarization is plotted as a function of the emission angle of the neutron. At $\theta = 9°$ the polarization $P = 0$, and changes sign with a maximum at $\theta = 30°$. At $\theta > 10°$ the polarization hardly depends on the angle of emission and remains equal approximately to its maximum value. (TTT)

26202 HAMMERTRACKS EMITTED IN 9 Bev PROTON INTERACTIONS WITH HEAVY PHOTOEMULSION NUCLEI. Wang, Ko-ming; Li, Huei Hsing; Chang, Hai-chiang; Ho, Mao Mao. Wu Li Hsueh Pao, 22: 127-35(Feb. 1966). (In Chinese).

By area scanning, 292 hammertracks formed in interactions of 9-Bev protons with heavy photoemulsion nuclei were obtained. The method of discriminating ^{8}Li, ^{9}Li, and ^{12}B fragments from the hammertracks is evaluated, and all the possible preferences in the scanning are analyzed. The distribution of stars with the hammertrack with respect to the number of rays, the frequency of ^{8}Li, ^{9}Li, and ^{12}B emission, and the energy and angular distributions of ^{8}Li fragments are given. The energy spectrum of the fragments is compared with evaporation theory. (tr-auth)

26203 PAIRING EFFECTS OF NUCLEI ON THE ANGULAR DISTRIBUTION OF THE FISSION FRAGMENTS. Zhu, Yei-zhung; Lee, Tse-ching; Lee, Ming-shou. Wu Li Hsueh Pao, 22: 136-45(Feb. 1966). (In Chinese).

The derivation of the moment of inertia for the ground state nucleus given by Migdal in the quasiclassical approximation is extended to the excited state case, i.e., $T \neq 0$. K_0^2, the parameter of the angular distribution of the fission fragments, is calculated. The results are compared with experimental data. Under the present approximation the anomalously small K_0^2 of fissioning nuclei in the uranium region at low excitation energy ($E_{exc} \lesssim 15$ Mev) can be explained by introduction of the pairing effects in nuclei. Furthermore, the absence of the anomalous phenomena for fissioning nuclei near the lead region may be qualitatively interpreted by means of the dependence of pairing effects on angular momentum. (auth)

26204 ANOMALOUS E1 TRANSITIONS IN DEFORMED ODD NUCLEI. Birbrair, B. L.; Feifrlik, V. (Ioffe Inst. of Physics and Tech., Leningrad). Yadern. Fiz., 3: 406-12 (Mar. 1966). (In Russian).

The absolute values of anomalous E1 transitions in deformed nuclei and their ratios were calculated on the basis of the quantum mechanical many-body theory. All parameters determining the interaction between quasiparticles are taken from previous work. The calculated results are in good agreement with the experiments. (auth)

26205 CALCULATIONS OF ANGULAR CORRELATION PARAMETERS FOR CONVERSION ELECTRONS. Listengarten, M. A.; Band, I. M. (Leningrad State Univ.). Yadern. Fiz., 3: 413-18(Mar. 1966). (In Russian).

The conversion-electron angular-correlation parameters were calculated for the L_I and L_{II} shells, for the atomic number in the region $49 \leq Z \leq 73$ and the transition energy $h\omega/mc^2$ between 0.05 and 0.7. Screening and finite dimensions of the nucleus were taken into account. A method of extrapolating the parameters to lower Z and higher energies is given. (auth)

26206 THEORY OF DIRECT PHOTONUCLEAR REACTIONS. Zaretskii, D. F.; Lushnikov, A. A.; Urin, M. G. Yadern. Fiz., 3: 432-8(Mar. 1966). (In Russian).

Direct photonuclear reactions, in which resonance effects connected with excitations of the "particle-hole" type in the intermediate states play a significant role, are considered, using the methods of the finite Fermi-system theory. The connection between the suggested approach and the optical method is established. An interpretation of some experimental data on (γN)- and (Nγ)- reactions is given on the basis of the obtained formulas. (auth)

26207 FAST NEUTRON INTERACTIONS WITH MATTER. Otstavnov, P. S.; Kolesov, V. E. Yadern. Fiz., 3: 439-43(Mar. 1966). (In Russian).

The dependence of the polarization of neutrons, with the mean energy 3.4 Mev, elastically scattered under the l.s. angle 30°, on the atomic weight and charge of the target nuclei, is investigated. The polarization is calculated according to the optical model. A singularity in the charge-dependence of the polarization is noted: the polarization has extremal values for elements with integer values of Z/3. (auth)

26208 DE-EXCITATION OF NICKEL NUCLEI AFTER THERMAL NEUTRON CAPTURE. Groshev, L. V.; Demidov, A. M.; Shadiev, N. Yadern. Fiz., 3: 444-8(Mar. 1966). (In Russian).

Schemes of γ transitions in the ^{59}Ni, ^{61}Ni and ^{63}Ni nuclei are constructed on the basis of data obtained measuring γ-ray spectra from (n,γ) reactions on Ni isotopes. The proton yields in the (d,p) reaction are compared with the γ-transition matrix elements from the initial state. The mechanism of thermal neutron capture in these nuclei is discussed. (auth)

26209 REACTION (n,α) ON Ag AND Br NUCLEI WITH 18-Mev NEUTRONS. Kuz'min, B. A.; Lefterov, D. P.; Ostroumov, V. I. Yadern. Fiz., 3: 449-54(Mar. 1966). (In Russian).

The (n,α) reaction on heavy nuclei in an emulsion was investigated for 18.3-Mev neutrons, using the nuclear photoplate method. The effective cross section of this reaction, averaged over all Ag and Br isotopes, was found

to be 14 ± 4 mbarns. The character of the α particle angular distribution indicates a considerable (40–50%) contribution of direct processes. The energy spectrum measured under angles <90° is enriched by high-energy α particles, whereas for the angles 120–180° it is described satisfactorily by the evaporation theory formulas, with the parameter a = 4.2 Mev^{-1}. (auth)

26210 EXPERIMENTS ON THE SYNTHESIS OF A SPONTANEOUSLY FISSIONABLE ISOMER IN THE ^{241}Am $(n,\gamma)^{242}Am$ REACTION. Markov, B. N.; Pleve, A. A.; Polikanov, S. M.; Flerov, G. N. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 3: 455-6(Mar. 1966). (In Russian).

The creation of a spontaneously fissionable ^{242m}Am isomer in reactions with thermal neutrons was investigated. It is shown that the cross section of this process is less than $3(10)^{-28}$ cm^2 and the isomerism ratio $\alpha < 5(10)^{-7}$. (auth)

26211 ANGULAR SPECTRA OF PROMPT NEUTRONS IN TERNARY FISSION OF ^{235}U NUCLEI. Nefedov, V. N.; Ivanov, O. I.; Kharin, V. P.; Tishin, A. S. Yadern. Fiz., 3: 465-7(Mar. 1966). (In Russian).

The spectra of prompt neutrons from the ternary fission of ^{235}U, emitted at the angle 0 and 180° to the direction of the long-range α particles, were measured by the time-of-flight method. An analysis shows that 27 ± 5% more neutrons are emitted in the direction of flight of the α particles, than oppositely. The neutron spectrum in ternary fission is similar to the two-particle fission spectrum. The mean energy and mean number of prompt γ quanta in the ternary fission of ^{235}U was determined. It was found that 6–6.5 prompt γ quanta with the mean energy E_t = 1.3 Mev are emitted in one ternary fission event. (auth)

26212 ELECTRONS EMITTED DURING FISSION AND BY FRAGMENTS IN FISSION OF URANIUM BY NEUTRONS OF VARIOUS ENERGIES. Belovitskii, G. E. (Lebedev Inst. of Physics, Moscow). Yadern. Fiz., 3: 468-75(Mar. 1966). (In Russian).

The emission of electrons from various parts of the fission product tracks, occurring in less than $2(10)^{-12}$ sec, was observed using the nuclear emulsion method. An excessive emission of electrons with the energies 20–100 kev, coming from the first parts of the fragment tracks, was detected, and is connected with the fission process. There were $(1.0 \pm 0.2)(10)^{-2}$ such electrons per fission event. Possible processes are discussed, which could lead to the emission of electrons during the fission. The portion of prompt γ radiation, emitted during the time $t < 2(10)^{-12}$ sec, was estimated from the experimental data on conversion electrons, emitted by the uranium fission fragments. For γ rays with energies less than 300 kev, assuming all the transitions to be of the E1 or E2 type, the portion of prompt γ radiation proved to be ~10 and ~3% respectively. For γ rays with energies higher than 300 kev the corresponding values are ~70 and ~30%. Results are obtained indicating that E1 transitions dominate in the prompt γ-ray emission. (auth)

26213 KINETIC ENERGIES OF THE FRAGMENTS IN FISSION OF ^{239}Pu BY THERMAL AND RESONANCE NEUTRONS. Borukhovich, G. Z.; Kaminker, D. M.; Petrov, G. A. (Ioffe Inst. of Physics and Tech., Leningrad). Yadern. Fiz., 3: 476-8(Mar. 1966). (In Russian).

The total kinetic energies of symmetric fragments from the fission of ^{239}Pu by thermal neutrons and by neutrons, transmitted through a samarium filter, were measured with the help of two surface-barrier semiconductor counters. The kinetic energies proved to be equal within the experimental errors (±2 Mev). The output of fragments in the symmetric region was about 30% lower for resonance neutron fission. The dependence of the total kinetic energy of the fragments and of the dispersion of this quantity on the mass ratio, was determined for the thermal neutron fission of ^{239}Pu. (auth)

26214 PHOTOPRODUCTION OF π^0 MESONS ON ^4He. Belousov, A. S.; Rusakov, S. V.; Tamm, E. I.; Tatarinskaya, L. S.; Shareiko, P. N. (Lebedev Inst. of Physics, Moscow). Yadern. Fiz., 3: 503-10(Mar. 1966). (In Russian).

The photon differential cross section from the meson (π^0) decay in the process $\gamma + {}^4He \rightarrow \pi^0 + {}^4He$ was measured. The measurements were performed for the decay photon ls emission angles θ_γ = 64, 96, and 144° for 10 values of bremsstrahlung energy in the region 160–260 Mev. The obtained differential cross sections agree with calculations, based on the impulse approximation for bremsstrahlung energies $E_\gamma \leq 200$ Mev. The best agreement between the experimental and theoretical data is achieved for the calculations in which the F_2^+ amplitude is used and the mean-square radius of the ^4He nucleus is r_{He} = 1.61 f. The differential cross section for the photocreation of π^0 mesons on ^4He was measured for the cms angle $\theta_\pi \approx 90°$ at 4 values of the bremsstrahlung energy in the region 170–240 Mev. (auth)

26215 INFLUENCE OF NUCLEON SHELLS ON THE ENERGY OF A NUCLEUS. Strutinskii, V. M. Yadern. Fiz., 3: 614-25(Apr. 1966). (In Russian).

Nuclear shells correspond to a certain inhomogeneous distribution of nucleons in the phase space, whereas the distribution in quasiclassical phenomenological models (the liquid drop model) is supposed to be homogeneous. Starting from this point, Nilsson's level scheme is used to calculate the shell model correction to the liquid-drop energy of the nucleus, as a function of the occupation number and deformation. Its value agrees with the well-known correction to the semiempirical formula for nuclear masses. The calculated nuclear deformations and borders of the regions of deformation are also in agreement with experiments. Pairing energy is taken into account, but plays no significant role. (auth)

26216 POSSIBLE γ-RADIATION MECHANISM IN REACTIONS WITH HEAVY IONS. Faingol'd, M. I. (Inst. of Nuclear Physics, Academy of Sciences, Uzbek SSR). Yadern. Fiz., 3: 626-9(Apr. 1966). (In Russian).

A possible mechanism of formation of a compound system is proposed with an electric dipole moment in the interactions of medium and heavy nuclei discussed by Babikov. It is shown that the production of such systems follows from the equations of motion, if the strong interactions between peripheral nucleons in nuclei at short distances are taken into account. The dependence of the γ-radiation energy on the energy of the ion beam is obtained. The cross section for γ-quantum emission in the creation of the compound nucleus is calculated making it possible to estimate the contribution of this process to the observed radiation. (auth)

26217 MEASUREMENTS OF THE YIELD RATIO FOR ^3He AND D PHOTOSPALLATION REACTIONS. Varfolomeev, A. T.; Gorbunov, A. N.; Taran, G. G. (Lebedev Inst. of Physics, Moscow). Yadern. Fiz., 3: 647-8(Apr. 1966). (In Russian).

The ratio of the reaction yields in ^3He and D photodisintegration was measured for the maximal bremsstrahlung energy 170 Mev, using a Wilson chamber. The obtained results are used to obtain the absolute values of the $^3He(\gamma,p)D$ and $^3He(\gamma,n)2p$ effective cross sections. (auth)

26218 DISINTEGRATION OF TWO-BODY SYSTEMS IN A COULOMB FIELD AT HIGH ENERGIES. Vedrinskii, R. V. (Rostov-on-Don State Univ., USSR). Yadern. Fiz., 3: 672-7(Apr. 1966). (In Russian).

The disintegration of two-body systems (like the deuteron) in the Coulomb field of heavy nuclei is studied in the high-energy approximation. The connection between this approximation, the trajectory approximation and the impact one is established. (auth)

26219 CAPTURE OF STOPPED π^- MESONS IN LIGHT NUCLEI. Kolybasov, V. M. Yadern. Fiz., 3: 729-38 (Apr. 1966). (In Russian).

The capture of stopped π^- mesons by α-particle type nuclei (^{12}C, ^{16}O) accompanied by the emission of fast neutrons, deuterons and tritium nuclei, is considered. The relative yields and energy spectra of final products are

calculated. It is shown that the experimental data are in agreement with the assumption on the dominant contribution of the pole α-particle diagram. (auth)

26220 NUCLEAR FISSION THROUGH QUASIMOLECULAR STATES. Shigin, V. A. Yadern. Fiz., 3: 756-61 (Apr. 1966). (In Russian).

A mechanism of nuclear fission through quasimolecular (QM) states is proposed. Arguments are given to the possible existence of such states. The stability of QM states with respect to the fusion and divergence of contacting nuclei is due to the nucleon structure in nuclei and the corresponding additional rigidity of nuclei with respect to deformation. However these states are not stable with respect to nucleon exchange between the nuclei. The account of QM states leads to new notions concerning the fission process, according to which fission proceeds as follows: A light nucleus grown on the surface of the fissile nucleus, because surface nucleons pass from the core, where their binding is weaker, into this light nucleus. Afterwards the produced quasimolecule diverges. The growth of the light nucleus starts from an α-particle. This mechanism allows a new approach to the problem of the fragment mass asymmetry and of the influence of the fragments shells on the fission process. Some of the fission regularities are explained on the basis of the QM mechanism. Experiments are suggested which can distinguish the QM and liquid drop fission mechanisms. (auth)

26221 DEMONSTRATION EXPERIMENTS ON NUCLEAR RESONANCE WITH PREPOLARIZED CONTINUOUSLY FLOWING LIQUIDS. Reimann, Richard; Eggensberger, Hans (Eidgenoessiche Technische Hochschule, Zurich). Z. Angew. Math. Phys., 17: 329-33(1966). (In German).

An experiment is described that demonstrates the influence of the magnetic induction on the polarization of nuclear spins. The sample used is distilled water which passes through a strong magnetic field where it becomes polarized. Afterwards the water is led into a weak magnetic field where an energy exchange occurs between the proton spins and the r-f-circuit of a spin detector while some of the initial polarization is still present. The prepolarizing process ensures better conditions for magnetic resonance experiments than the usual static method. (auth)

26222 METHOD FOR CALCULATING THE RELATIVISTIC COULOMB SCATTERING AMPLITUDES OF ELECTRONS. Buehring, Wolfgang (Univ., Heidelberg). Z. Phys., 192: 13-28(1966).

A method for calculating the coefficients for the power series representing the scattering amplitudes for the scattering of electrons by a point-charge nucleus is described. The method makes extensive use of recurrence relations and does not contain any approximation. (G.O.Y.)

26223 ELASTIC ELECTRON SCATTERING ON TITANIUM AT 33 TO 58 Mev. Engfer, Roland (Technische Hochschule, Darmstadt, Ger.). Z. Phys., 192: 29-50(1966). (In German).

The cross sections for electron elastic scattering were measured for Ti relative to C and Be for electron energies between 33 and 58 Mev and for angles of 33 to 165°. Phase-shift calculations of the scattering cross section showed that the rms radius determined from the measurements is alsmost independent of specific assumptions about the charge distribution. The results were in good agreement with measurements of the 2p−1s transition energy in the μ-mesic Ti atom. (G.O.Y.)

26224 ELECTROEXCITATION OF GIANT MULTIPOLE RESONANCES IN THE DYNAMIC COLLECTIVE THEORY. Drechsel, Dieter (Univ., Frankfurt am Main). Z. Phys., 192: 81-98(1966).

The electroexcitation of giant multipole resonances in heavy nuclei is studied. The cross sections are derived using a phase-shift analysis for the electron wave functions. The coupling between giant resonances and surface oscillations is taken into account. It is shown that the quadrupole giant resonance levels should be observed very clearly at electron scattering angles of about 40° with a primary electron energy of about 200 Mev. (D.C.W.)

26225 THEORY OF THE GIANT RESONANCE IN SPHERICAL NUCLEI. II. THEORY AND EXPERIMENT. Huber, Max G.; Weber, Hans J.; Greiner, Walter (Univ., Frankfurt am Main). Z. Phys., 192: 223-44(1966). (In German).

The dynamic collective theory was developed for vibrational nuclei in a previous paper. Here the details are studied and compared with experiments. For this purpose the structure of the dipole operator was established, the energy matrix of the dipole-quadrupole interaction was diagonalized and the various approximations are discussed quantitatively in detail. It is interesting that this systematic theory gives the details of the γ-absorption cross section in many nuclei. (auth)

26226 PROTON SPECTROSCOPY IN THE REACTION Ni(n,p)Co AT A NEUTRON ENERGY OF 14 Mev WITH A TELESCOPE OF SEMICONDUCTOR DETECTORS. Flohrs, P.; Hofmann, A. (Univ., Erlangen-Nuernberg, Ger.). Z. Phys., 192: 264-70(1966). (In German).

Protons from nuclear reactions induced by 14 Mev neutrons are analyzed with solid state detectors. A high background is caused by nuclear reactions in silicon. The application of a telescope with two dE/dx-detectors allows to suppress this background extensively. Proton identification is made by use of a two-dimensional analyzer. The telescope is tested by recoil protons with polyethylene. This arrangement may also be used as a neutron spectrometer. The proton spectra from the reaction Ni(n,p)Co in forward direction (0°) and on an angle of 90° are compared. Nuclear temperature and level-density parameter are evaluated from statistical theory plots. The contribution of direct processes is estimated. (auth)

26227 CROSS SECTION OF THE REACTION $^{16}O(\gamma,t)$. Goldmann, A.; Kneisel, P.; Buttlar, H. v. (Technische Hochschule, Darmstadt, Ger.). Z. Phys., 192: 282-3 (1966). (In German).

The tritium yield from irradiation of water with bremsstrahlung was determined in the energy range from threshold to 54.5 Mev. The tritium activity was measured using a low-level gas counter. From a smoothed yield curve, the approximate shape of the cross section was inferred. (auth)

26228 THE DECAY OF ^{56}Co. Schoenberg, R.; Schumacher, M.; Flammersfeld, A. (Univ., Goettingen, Ger.). Z. Phys., 192: 305-12(1966). (In German).

The γ ray spectrum of ^{56}Fe associated with the E.C.- and β^+-decay of ^{56}Co was measured with Ge(Li)-crystals. 6 new γ-ray-transitions were found in this spectrum de-exciting 3 new levels in ^{56}Fe. The intensities of these transitions were estimated and a new level-scheme is proposed. The new levels could be identified with some of previously reported levels found in $^{56}Fe(p,p')$-measurements. (auth)

26229 CONVERSION COEFFICIENTS OF TRANSITIONS IN ^{111}Cd BY A NEW PRECISION METHOD. Sparrman, P.; Marelius, A.; Sundstroem, T.; Pettersson, H. (Univ., Uppsala). Z. Phys., 192: 439-48(1966).

An electron-electron coincidence method for precise measurements of internal conversion probabilities is described. By using K-Auger electrons, the atom itself provides a unity standard in the same nuclear decay. The method is applied to the decay of ^{111}In in which the K-conversion probability of the 245-kev transition is determined to be 0.0494 ± 0.0011. Relative internal conversion intensities and transition energies are determined using a double focusing spectrometer. These data make it possible to calculate conversion coefficients for all electron shells. (auth)

26230 MEASUREMENT OF THE HALF LIFE OF EXCITED NUCLEAR LEVELS OF ^{155}Gd. Krusche, A.; Bloess, D.; Muennich, F. (Technische Hochschule, Brunswick). Z. Phys., 192: 490-501(1966). (In German).

The half lives of the 60.0- 86.5-, and 105.3-kev levels of

^{155}Gd were measured using the method of delayed coincidences. The results were compared with the predictions of the collective model. (D.C.W.)

26231 ENERGY SPECTRA AND YIELDS OF PHOTO-α-PARTICLES FROM Al, Ar, Se, AND Ag. Wendling, R.; Kosiek, R. (Univ., Heidelberg). Z. Phys., 192: 502-9 (1966). (In German).

The energy spectra and yields of alpha particles produced in the irradiation of natural Al, Ar, Se, and Ag with 32.5-Mev bremsstrahlung were measured. The results were in qualitative agreement with the results of calculations in which a simple compound-nucleus model was used. (D.C.W.)

26232 IZOBARNYE YADRA S MASSOVYM CHISLOM A = 157. (Isobaric Nuclei with Mass Number A = 157). Dzhelepov, B. S.; Dranitsyna, G. F.; Zvol'skii, I. Moscow and Leningrad, Izdatel'stvo Nauka, 1966. 103p.

Isobaric nuclei with mass number 157 (Sm, Eu, Gd, Tb, and Dy) are treated. On the basis of a critical analysis of all experimental works and theoretical calculations, highly reliable data on the energies and intensities of radiations, decay schemes, lifetimes, and quantum characteristics of excited levels are presented. (tr-auth)

26233 GIANT RESONANCES IN NUCLEI. Walecka, J. D. (Stanford Univ., Calif.). pp 59-69 of Preludes in Theoretical Physics. Amsterdam, North-Holland Publishing Co., 1966.

Simple observations concerning giant resonances in nuclei are presented. The giant electric dipole resonance, which falls in the region 15–25 Mev for the heaviest to the lightest nuclei, is discussed using the model by Goldhaber and Teller, in which the protons are assumed to move as a unit against the neutrons. This mode of motion is described with regards to the exhaustion of the dipole sum rule and oscillations which are degenerate with the giant electric dipole resonance. The techniques of group theory are presented to further investigate the characteristics of the giant electric dipole resonance. (B.G.D.)

26234 MULTIPOLE RADIATION. Gottfried, Kurt (Cornell Univ., Ithaca, N. Y.). pp 210-17 of Preludes in Theoretical Physics. Amsterdam, North-Holland Publishing Co., 1966.

A review of standard results in the field of quantum mechanics with regards to multipole radiation is presented. It is shown that a fairly concise and straightforward development of the multipole fields and moments is possible if one uses the notion of helicity states introduced by Jacob and Wick. (B.G.D.)

26235 INELASTIC SCATTERING AND ASSOCIATED GAMMA RADIATION. Inglis, David R. (Argonne National Lab., Ill.). pp 218-30 of Preludes in Theoretical Physics. Amsterdam, North-Holland Publishing Co., 1966.

An examination of the phenomenon of inelastic scattering, taking into account the mechanism of the nuclear excitation on but still retaining the simplification of an approximately black nucleus is discussed. An attempt is made to formulate a mechanism which could account for the rotation of the associated gamma pattern. (B.G.D.)

26236 STUDIES OF HYPERNUCLEI WITH K MESON BEAMS. Feshbach, H.; Kerman, A. K. (Massachusetts Inst. of Tech., Cambridge). Contract AT(30-1)-2098. pp 260-5 of Preludes in Theoretical Physics. Amsterdam, North-Holland Publishing Co., 1966.

The hypercharge exchange reactions in which the final state consists of a hypernucleus and a π or K meson lead to suggestions of experiments in which the Λ hyperon bound in the hypernucleus probes the properties of the nuclear core. It differs from other probes in that it has the baryon mass, baryon spin, and the baryon strong interaction, but since it is not a nucleon need not satisfy the Pauli principle. The energy spectrum of the hypernucleus, the energy and width of the hyperonic analog states if they exist as a function of mass number would furnish data from which the properties of the nuclear core with which the Λ interacts can be determined. (B.G.D.)

26237 COHERENT HIGH-ENERGY REACTIONS WITH NUCLEI. Goldhaber, Alfred S. (Univ. of California, Berkeley); Goldhaber, Maurice. pp 313-20 of Preludes in Theoretical Physics. Amsterdam, North-Holland Publishing Co., 1966. (BNL-9493).

A brief review of various notions on the use of atomic nuclei as targets in high energy elementary particle physics is presented. The main concern of this review is coherent reactions, in which the target nucleus remains intact. (B.G.D.)

26238 DIFFRACTION SCATTERING OF STRONGLY ABSORBED PARTICLES. Ericson, T. E. O. (CERN, Geneva). pp 321-9 of Preludes in Theoretical Physics. Amsterdam, North-Holland Publishing Co., 1966.

Two phenomenological approaches are presented for the description of the elastic scattering on nuclei of nucleons, deuterons, alpha particles, and heavy ions. The first, and the commonest, approach is that of a complex optical model potential. The second approach tries directly to make an intelligent approximation to the partial-wave amplitudes η_L as a function of L, and to single out those features of η_L on which the scattering amplitude depends crucially. (B.G.D.)

Plasma Physics and Thermonuclear Processes

See also Fluid Physics and Thermodynamics

Refer also to abstracts 24978, 25710, 25772, and 25994.

26239 (CEA-R-2935) ETUDE DE LA COLONNE DE PLASMA DANS UN ARC A ELECTRODES CREUSES. (Study of the Plasma Column in Hollow-Electrode Arc). Cano, Renato; Mattioli, Mario; Zanfagna, Bruno (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Jan. 1966. 68p. (EUR-2645.f). Dep. mn.

A steady state hollow electrode arc was built. The density of the plasma column obtained varies between 1.5 10^{13} cm^{-3} and 8.10^{14} cm^{-3} when the argon feed rate is varied from 0.2 and 30 l/h S.T.P. and the corresponding values of the electron temperature vary from at least 15 to 1 ev. Three diagnostic methods were utilized: electrostatic probes, far-infrared emission (wave length between 10 and 0.1 mm) and microwave techniques utilizing either the transmitted or the reflected wave. The results obtained are described in detail and compared. Limits of utilization of the different techniques are given. (auth)

26240 (D-1-82-0502) THE FORMATION OF A MAGNETIC PINCH IN InSb AND THE POSSIBILITY OF POPULATION INVERSION IN THE PINCH. Schmidt, Helmut (Boeing Scientific Research Labs., Seattle, Wash. Plasma Physics Lab.). Feb. 1966. 42p. Dep. mn.

A sufficiently strong current supported by an electron-hole plasma in InSb pinches was investigated. As the electron-hole gas is compressed by the current's magnetic field, the plasma temperature increases. The strong electron-phonon coupling, however, keeps the plasma temperature below the characteristic temperature of the optical phonons as long as the lattice remains cold. This early period of the pinch is discussed, which includes the initial contraction and some 10^{-7} sec thereafter. The collapse of the pinch may be halted by an increase of the plasma pressure caused by the exclusion principle or by the occurrence of impact ionization in the pinch's radial Hall field. An estimate of the particle density in the pinch shows that the conditions for population inversion may be satisfied, hence laser action due to stimulated electron-hole recombination might occur. This effect should influence the development of the pinch decisively. (auth)

26241 (IPP-1/43) STRAHLUNGSVORIONISIERUNG VON WASSERSTOFF. (Preionization of Hydrogen by Radiation). Hofmann, G. (Institut fuer Plasmaphysik, G.m.b.H., Garching (West Germany)). Mar. 1966. 32p. Dep. mn.

A light source was developed which emits a very intense short radiation pulse below 800 Å. By this device molecular hydrogen could be ionized sufficiently to be used as the starting point for a heating experiment (theta pinch). This light source is a fast high voltage z-pinch which is filled dynamically, only for the duration of the ionizing light pulse, with dense lithium vapor. The electron density of the photo-ionized hydrogen was measured with a Microwave-Interferometer; the electric conductivity was determined from the skin-effect. In the center of a tube of 150 cm length and 4 cm radius a degree of ionization of 4.5% can now be reached with an initial pressure of 0.01 Torr H_2 using two light sources at both ends. The conductivity is so high that a magnetic field of 500 kHz penetrates only 0.5 cm. The electron temperature was determined from the conductivity as some ev while the ions remain cold. (auth)

26242 (IPP–2/46) EFFECTS RELATED TO THE RADIAL ELECTRIC FIELD IN A Q-MACHINE. Grieger, G. (Institut fuer Plasmaphysik, G.m.b.H., Garching (West Germany)). Mar. 1966. 27p. Dep. mn.

In a Q-machine with end plates heated to a uniform temperature there must exist a radial electric field proportional to the gradient of the particle density, thus being a consequence of a deviation from the equilibrium case. This radial component of the electric field has an influence on the velocity distribution of the ions and leads—for a certain range of particle densities—to increased loss rates of ions. The calculations were performed under the assumption of an electron sheath on the end plate and by taking into account the centrifugal forces acting on the ions. (auth)

26243 (IPP–3/33) SLOW WAVE TRANSMISSION MODES OF AN ISOTROPIC INHOMOGENEOUS CYLINDRICAL HOT PLASMA. O'Brien, Benedict B. Jr. (Institut fuer Plasmaphysik, G.m.b.H., Garching (West Germany)). Nov. 1965. 77p. Dep. mn.

The dispersion relations for coupled electromagnetic waves and longitudinal waves propagating along a plasma column are derived and experimentally measured. The "hot" plasma is described by the equations of the two fluid model which include a gradient pressure term. A quasi-static approximation, $E = -\text{grad}\ \phi$, is used in place of the complete electromagnetic equations. The ω-β curves (β is the propagation constant along the column) were calculated for modes which have none and one azimuthal variation. The measurements, performed on the positive column of a mercury vapor discharge, show the presence of many bands of propagation corresponding to many nodes in the radial direction. The theoretical and experimental results are in agreement. (auth)

26244 (IPPJ–47) A MODEL OF DISPERSIVE NONLINEAR EQUATION. Yajima, Nobuo; Outi, Akizi; Taniuti, Tosiya (Institute of Plasma Physics, Univ. of Nagoya (Japan)). Feb. 1966. 20p. Dep. mn.

A model of a dispersive, nonlinear equation, which is derived from the Schroedinger equation by means of a nonlinear transformation, is considered. The derivation is closely analogous to the derivation of the Burgers model from the diffusion equation. A solution resulting from an initial discontinuity is then obtained, corresponding to that of the Riemann's problem in the Burgers model. In the solution obtained, the limit in which the Planck constant vanishes is discussed in comparison with the dissipative limit in the Burgers model, which is realized by letting a dissipation constant tend to zero. It is shown explicitly that in these limits the equations in the two models are the same; nevertheless, their solutions are entirely different. For example, as is well known in the Burgers model, one discontinuity develops from the initial discontinuity, while in the present model two discontinuities develop, across each of which the so-called generalized Rankine-Hugoniot relations are not valid. (auth)

26245 (LA–3369) DESIGN AND USE OF A HIGH-POWER LASER FOR PLASMA GENERATION STUDIES. Mace, Phillip N. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). Aug. 1965. Contract W-7405-eng-36. 56p. Dep. mn. CFSTI $3.00 cy, $0.50 mn.

The advent of high power lasers to the technological scene has introduced the possibility of creating new effects utilizing the interaction of this high intensity light with matter. C. M. Fowler and D. B. Thomson of LASL suggested in 1963 the possibility of using a high power laser to pre-ionize and heat a target material to be contained in an explosively driven theta pinch machine. Consequently an effort was undertaken to design and build a suitable laser for some feasibility studies. A 50-MW laboratory laser was built; however, it became possible to use a higher power commercial laser which had the advantage of being more nearly a "tool" rather than a "breadboard" device, and was therefore more amenable to experimental investigation of laser-produced plasmas. This laser was used to produce plasmas in a thin polyethylene target. A two-coil magnetic field system was built to allow the investigation of magnetic containment problems. The following measurements were made: (1) high speed framing camera photographs of the plasma, (2) still 35 mm camera photographs using Kodak X-R type film, (3) spectrographic measurements using a Hilger medium quartz non-time resolved spectrograph, (4) gas laser light absorption measurements, (5) individual spectral line intensity vs time measurements using a Jarrell–Ash monochromator, and (6) ion energies using an optical time-of-flight measuring technique. The results indicate that a plasma having a "temperature" of a few electron volts and a directed energy of several kiloelectron volts is produced by the laser beam. The discrepancy between the thermal energy and the directed energy is attributed to the lack of thermal equilibrium in the plasma. The application of a 20 kilogauss magnetic field increases the apparent "temperature" of the plasma and reduces the directed energy. The feasibility of producing a highly ionized plasma in a moderately low-Z target was demonstrated. Further studies of simpler atomic systems are recommended, particularly in conjunction with more highly refined measurements of plasma temperature, density, and containment effects. (auth)

26246 (LA–3416) COMPUTATION OF ELECTROSTATIC AND RAPIDLY PULSED MAGNETIC FIELDS. Crandall, K. R.; Lewis, H. R. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). Oct. 1965. Contract W-7405-eng-36. 103p. Dep. mn. CFSTI $4.00 cy, $0.75 mn.

It is often required, for example, in the design of some pulsed controlled-thermonuclear-fusion experiments, to calculate electrostatic fields and to calculate magnetic fields in the approximation that flux does not penetrate metal boundaries of the experimental volume. Computation of such magnetic and electric fields by means of the standard relaxation methods is often difficult and very costly, even with high-speed computers. This is because the boundaries of the region of experimental interest are rather arbitrary, and because there are generally current- or charge-carrying conductors within the region that make it nonsimply-connected. An alternative method of solving the boundary-value problems that determine these electric and magnetic fields, which does not involve a difference approximation to the differential equations, was developed. With this method, an exact analytic solution of the appropriate differential equation is obtained in the region of interest, and this solution is made to approximate the boundary conditions. The method and its application are described in detail. Examples of the application of the method to some controlled-thermonuclear-fusion experiments are given. (auth)

26247 (MPI-PAE–P1.21/65) LADUNGSTRAEGER-VERLUSTE IN EINEM SCHWACHIONISIERTEN STATIONAEREN GLEICHSTROMPLASMA IM TOROIDALEN MAGNETFELD. (Particle Losses in a Weakly Ionized Stationary DC Plasma in a Toroidal Magnetic Field). Karger, F. (Max-Planck-Institut fuer Physik und Astrophysik, Munich (West Germany)). Dec. 1965. 59p. Dep. mn.

For the particle losses of a weakly ionized plasma which result from the torus-drift in the curved magnetic field, an expression is derived which is valid for certain parameters of the positive column of a gas discharge. To check this

theory the "AMBIPOL" device was built; with this device it was possible to measure simultaneously the losses both in the toroidal and in the linear magnetic field by measuring the longitudinal electric field strength. As theory predicts, a weaker decrease of the longitudinal electric field was observed in the toroidal part of the discharge as compared to the linear part. The measured values of the relative electric field strength, however, exceed the theoretical limit, although the measurements of the electric field in the straight part and the measurements of the particle density and of the electron temperature in the curved part are consistent with theory. Moreover, contrary to the expectations, the onset of the KADOMTSEV instability occurs at lower critical magnetic fields in the toroidal part than in the straight part. Seven explanations are discussed. (auth)

26248 (N-65-33300) TWO-STAGE MAGNETIC MIRROR COMPRESSION EXPERIMENT WITH A ROTATING PLASMA SOURCE. Forsen, H. K. (California Univ., Berkeley. Electronics Research Lab.). June 7, 1965. Contract AF33(615)-1078. 158p.

A two-stage magnetic mirrow compression experiment was constructed to investigate a rotating plasma as a clean, high-temperature plasma source. Kilovolt deuterons were created in the crossed electric and magnetic fields of the first stage and were transferred or injected into the second stage. Measurements were made on the plasma to determine energy density, ion energy distribution, electron temperature, impurity content, and neutron flux. To transfer the plasma out of the first stage to the second stage, two methods were used: one involved sequentially energizing the first-stage coils to move the plasma into the second-stage mirror field; and the other involved ionization in a gradient field which directly injects the plasma into the second stage. In the process of transfer, the plasma leaked out of the first stage. The escaping deuterons were given additional axial acceleration by the fringing electric field at the tip of the anode which extends through the first stage and ends between the two stages. (STAR)

26249 (N-65-36897) SUPERCONDUCTING MAGNETIC BOTTLE. Laurence, James C.; Coles, Willard D. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). 1965. 15p. (NASA-TM-X-52115). CFSTI $1.00 cy, $0.50 mn.

A superconducting magnetic bottle consisting of two mirror coils, a central field coil, and a cylindrical cusp field coil was designed and constructed of Nb-Zr cable. The configuration was designed to investigate the problems involved in using superconducting materials to produce magnetic fields useful for experiments in plasma physics. Fields as intense as 50 kgauss were produced in 4-in. inside-diameter coils with a superimposed quadrupole cusp field of 5 to 10% of the center field and a mirror ratio of 2. (STAR)

26250 (NASA-CR-446) MEASUREMENT AND INTERPRETATION OF PLASMA PROPERTIES TO 100 KILOBARS OF PRESSURE [Thesis]. Robinson, James W. (Michigan Univ., Ann Arbor). Apr. 1966. 108p. CFSTI $1.25 cy.

Plasmas were produced at near-liquid densities, and measurements of thermodynamic properties were made for these conditions. The range of pressures investigated was too high for static confinement, so the plasmas were generated under water which provided transient inertial confinement. Experimental data were obtained at pressures of 4, 7.7, and 115 kilobars. Pressure at the two lower levels was produced by the inertial restraint of the water which surrounded the expanding column of plasma. The pressure at the higher level was produced by detonating an explosive charge in the water in the vicinity of the plasma column. At each level of pressure, the temperature, pressure, and internal energy of the plasma were determined experimentally. At the lower pressure levels, internal energy was predicted from temperature and pressure data by the use of the Debye-Hückel theory of shielding. The predicted values were lower than the measured values by a factor of five, so a different theoretical approach was sought. A calculation based upon the quantum mechanical virial theorem introduced the strong cohesive forces which were needed to explain the measurements. At the higher pressure where temperature was much lower, the plasma was treated as a partially dissociated gas of water molecules with a very low fraction of ionization. The equation of state was modified by the introduction of a covolume which was required because of the high density of the plasma. (auth)

26251 (NASA-CR-67221, pp 2,2-5) INVESTIGATION OF Na-K SEEDED ARGON PLASMA. Yeh, Hsuan; Gottschlich, Chad F.; Chu, T. K. (Pennsylvania Univ., Philadelphia. Inst. for Direct Energy Conversion). 7p.

Research directed toward the measurement of the nonequilibrium ionization and its effects in an alkali metal (Na-K) seeded argon plasma, where the nonequilibrium ionization is produced by an externally applied electric field, is reported. Apparatus for making spectrophotometric measurements of the radiation from the plasma is described. (M.O.W.)

26252 (NASA-CR-67221, pp 2,12-21) THEORETICAL AND EXPERIMENTAL INVESTIGATION OF A ROTATING PLASMA IN A CROSSED ELECTRIC AND MAGNETIC FIELD. Altman, M.; Brull, M. A.; Hsueh, P. (Pennsylvania Univ., Philadelphia. Inst. for Direct Energy Conversion). 12p.

A brief review of previous work on rotating plasma in crossed electric and magnetic fields is presented. An extension to this earlier work is proposed. The experimental and theoretical techniques to be used are briefly outlined. (M.O.W.)

26253 (NP-15974) THE STABILITY OF A PINCH DISCHARGE, WITH FINITE SOUND VELOCITY, IN A ROTATING MAGNETIC FIELD. Rijnhuizen Report 66-28. Beiboer, F. G. (Stichting voor Fundamenteel Onderzoek der Materie, Jutphaas (Netherlands). Instituut voor Plasma-Fysica). Apr. 1966. 103p. Dep. mn.

The stability of a gaseous cylindrical pinch discharge under the pressure of a rotating magnetic field is investigated. The fluid is supposed to be perfectly conducting, nonviscous, but compressible. This constitutes an extension of the work done by H. C. Brinkman, Tayler and Berkowitz, who only considered an incompressible fluid. They found that the stability was governed by a Mathieu equation. The characteristic equation replacing the latter in this more general case had to be derived. The displacement in the radial or r-direction of the plasma vacuum boundary away from its equilibrium position is used as an independent variable. Applying Laplace transforms depending on the corresponding variable s, the characteristic equation appears to consist of a three-term difference equation: one term with argument s and two terms with arguments $(s + 2i\omega_0)$ and $(s - 2i\omega_0)$ respectively. The latter terms are consequences of the rotating radio frequency field, having a frequency ω_0. These two terms are multiplied by a factor which is an explicit function of s. The factor can be split into fractions, each of which determines a possible mode of vibration in the r-direction, when the impressed frequency ω_0 tends to infinity. Vibrations with radial symmetry prove to be predominant (m = 0). All calculations concern this type of motion. Limiting cases are considered; e.g. infinite values of the velocity of sound, of the Alfvén velocity and of the impressed frequency. Instabilities always prove to occur in the first of these cases; the two others are not necessarily unstable. In order to put the general characteristic equation into a convenient form, the factor in front of the terms with the arguments $(s + 2i\omega_0)$ and $(s - 2i\omega_0)$ had to be split into the above-mentioned fractions. The lowest frequency constituting the smallest pole of this factor, considered as a function of s, and the associated residue show a very great similarity to the corresponding quantities entering in the Mathieu equation for the incompressible fluid. Two new types of vibration appear from the theory, viz. waves showing mainly either an Alfvén or an acoustical character. The phase velocity of the former type may have all values from infinity to zero when a large internal magnetic field does exist inside the plasma. The higher modes of both

these types of waves appear to be unimportant, mathematically as well as physically. The stability boundaries of the first mode are determined with the aid of continued fractions. This radial mode appears to be predominant. Considering the succession of perturbations associated with increasing wave numbers, it is found that stable and unstable regions are passed alternately. The stability boundaries separating both types of regions are shifted with respect to those of the Mathieu equation for the corresponding incompressible fluid. In general the increment of the unstable perturbations appears to be of an order between 1, 32 and 1, 77 times the operating frequency, its value decreasing when the wall approaches the outer plasma boundary. Conditions involving purely periodic vibrations are derived. The conditions are discussed under which the application of the magnetohydrodynamic equations in the form used in this investigation is admissible. (auth)

26254 (NYO–3578-3) PRODUCTION OF PLASMAS FOR THERMONUCLEAR RESEARCH BY LASER BEAM IRRADIATION OF SOLID PARTICLES. Quarterly Report, January 1, 1966–March 31, 1966. Haught, Alan F.; Polk, Donald H. (United Aircraft Corp., East Hartford, Conn. Research Labs.). Mar. 31, 1966. Contract AT(30-1)-3578. 24p. (UARL–E920365-3). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

During this report period techniques were developed which reduced the operation of the laser to a simple routine with the desired laser pulse available on demand and which improved the reproducibility of the data obtained from the charge collectors. In addition, control circuitry was installed to synchronize the operation of the laser, plasma diagnostics, and the pulsed magnetic field for magnetic field containment experiments. Using the system developed, experimental studies were made of interaction of the laser irradiated single particle plasmas with magnetic fields of mirror and cusp geometry. With no magnetic field, the plasma expansion is isotropic in space. In a simple mirror magnetic field, however, using charge collectors located both normal to and along the mirror axis, a much lower rate of ion collection and a lower total charge are observed as compared with the field free case. The lower rate of ion collection indicates that some magnetic field confinement has occurred, and the lower total charge collection is consistent with plasma loss primarily through the mirror loss cones. Using a cusp magnetic field, the same low rate of iron collection obtained with the mirror field is observed with all of the charge collectors, indicating again that some magnetic field containment has occurred. While reduced total charge collection was obtained with the charge collector located on the axis of the point cusp, the charge collector located normal to that axis showed the same total charge collection as obtained with no magnetic field, a result which indicates significant losses through the line cusp for this magnetic field geometry. Although the hydrodynamic model of the plasma expansion described in the second quarterly report has led to an understanding of the radial density distribution within the plasma, it is highly complex and requires a large amount of machine computation time for any given case. As a result, a modification was made in the uniform density model developed earlier to include a linear radial gradient as a first approximation to the density profile in the expanding plasma. For this density profile, the plasma expansion rate was determined and calculations were made of the energy input to the plasma from the focused laser beam. The resulting energy was compared with that derived on the basis of the complete hydrodynamic model, and in all cases excellent agreement was obtained. The simpler calculations permitted by the linear gradient model allow an evaluation of the effect of different experimental parameters on the plasma energy. Using this model, calculations were carried out to determine the influence of varying particle size, laser pulse shape, local spot size, and laser pulse energy on the average energy of the plasmas produced. The results obtained are similar to those derived using the uniform density model but, since the plasma density profile is taken into account, are more representative of the results to be expected experimentally. (M.O.W.)

26255 (ORNL–3938) PRELIMINARY REPORT ON BALL LIGHTNING. McNally, J. Rand Jr. (Oak Ridge National Lab., Tenn.). May 1966. Contract W-7405-eng-26. 22p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

An extension of remarks made in a 1960 paper is presented. Though out of date in several respects (e.g., the possible roles of active nitrogen and of self-binding plasma forces, etc.) and perhaps erroneous in others, the original unpublished report is still being requested by individual scientists and reference agencies. The report, with minor changes, is now (March, 1966) being placed in official documentation channels to make it more readily available to interested sources. The following abstract accompanied the oral paper: "Ball lightning is a possible stable plasma configuration and hence may merit some consideration in the field of thermonuclear research. A survey of 15,923 Union Carbide Nuclear Company personnel in Oak Ridge was made with 498 reports of unusual lightning phenomena which the observers thought may have been related to ball lightning. Some of the results of the survey are presented." (auth)

26256 (R–66SD19) CALCULATIONS OF OPTIMUM SEED CONCENTRATIONS IN CESIUM AND POTASSIUM NON-EQUILIBRIUM PLASMAS. Smith, J. Marlin; Shair, F. H. (General Electric Co., Philadelphia, Pa. Missile and Space Vehicle Dept.). Mar. 1966. Contract NAS-3-6260. 18p.

The electric conductivity of a gas can be enhanced by the use of a mixture of a parent gas of small electron elastic collision cross section (typically a noble gas) seeded with a gas of low ionization potential (typically an alkali metal). Further enhancement for a given gas temperature is possible through the creation of a non-equilibrium condition where the electron temperature is higher than the gas temperature. An extention for the optimum seed concentration in a nonequilibrium plasma is obtained for conditions applicable to MHD power generators or positive columns of discharges. This result is applied to cesium and potassium seeds and it is shown that the concentration of seed at optimum conductivity is one to two orders of magnitude lower than it is in the equilibrium plasma. (auth)

26257 (SU-IPR–52) BIBLIOGRAPHY OF STANFORD REPORTS, PAPERS AND CONFERENCE PRESENTATIONS ON PLASMA PHYSICS. (Stanford Univ., Calif. Inst. for Plasma Research). Feb. 1966. 70p.

26258 (SU-IPR–59) STUDIES OF PLASMA OSCILLATIONS. Quarterly Status Report No. 25, December 1, 1965–February 28, 1966. Crawford, F. W. (Stanford Univ., Calif. Inst. for Plasma Research). Mar. 1966. Contract AT(04-3)-326. 40p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Further experimental and theoretical research is reported on each of the following four projects: ion wave propagation and positive column instabilities; electron beam probing of plasmas; beam/plasma interactions; and positive column resonances and propagation. A steady-state theory and low-frequency perturbations leading to wave propagation and instabilities in a positive column were investigated in the absence of a magnetic field. (M.O.W.)

26259 (TID–22881) THIRD QUARTERLY PROGRESS REPORT ON PLASMA RESEARCH, JULY 1–SEPTEMBER 30, 1965. (California Univ., Berkeley. Electronics Research Lab.). Sept. 1965. Contracts AF33(615)-1078; AT(11-1)-34. 42p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

The hot-electron experiment operated satisfactorily during this period. Effort was concerned with obtaining adequate data to determine the absolute intensity of the synchrotron radiation emitted by the hot-electron plasma. Brief discussions of results are given on the synchrotron radiation measurements, electron cyclotron heating, and plasma diagnostics with a laser. An investigation was made to determine adiabatic compression of a plasma with turbulent heating of ions at the ion-cyclotron frequency by electron beam excitation of ion waves. An r-f ion source for an ion-energy analyzer is being developed. Brief discussions

are presented on related experimental and theoretical research. (M.O.W.)

26260 (AEC-tr-6670) NUCLEAR FUSION. Translated Selected Articles. Translated from Nucl. Fusion, 5: 125-43; 150-5(1965). 68p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

Abstracts of the 3 included papers appeared previously in NSA as: 20: 3208, 3209, and 3210. (M.O.W.)

26261 EFFECT OF NONLINEAR TERMS ON THE ELECTROMAGNETIC FIELD IN AN IONIZING GAS. De Socio, Marialuisa. Atti Accad. Naz. Lincei, Rend., Cl. Sci. Fis., Mat. Natur., 38: 860-5(June 1965). (In Italian).

In a previous study the propagation of a spherical wave in ionized gas generated by a superposed magnetic and electric dipole was investigated, and it was shown that under the hypothesis $\mu = 0$ the contribution of the inertia terms and the Lorentz terms in the expression of the magnetic field are compensated in the proximity of the wave front. It is shown that this result is valid in general and not only in the proximity of the front if N is assumed constant in all space. (J.S.R.)

26262 EQUILIBRIUM COMPUTATIONS FOR MULTICOMPONENT PLASMAS. Zeleznik, Frank J.; Gordon, Sanford (National Aeronautics and Space Administration, Cleveland). Can. J. Phys., 44: 877-93(Apr. 1966).

A method is presented for the calculation of multicomponent plasma properties. The method includes both Debye-Hückel and ionization potential lowering effects. These effects are shown to be partially compensating. A perturbation technique is used to make the calculation compatible with a scheme used for calculating ideal gas properties. Thermodynamic derivatives, such as heat capacity, can be calculated directly. (auth)

26263 EQUATION OF STATE OF A HYDROGEN-LIKE PLASMA. Roger, Claudine; Salmon, Jean (Conservatoire National des Arts et Metiers, Paris). Compt. Rend., Ser. A, 262: 727-9(Mar. 21, 1966). (In French).

It is shown that the system of four integral equations expressing the correlations for equilibrium in a hydrogen-like plasma is reducible to a single equation. A resolution method for this equation is proposed. The equation of state of the plasma and the internal energy are obtained. (tr-auth)

26264 USE OF POLARIZED COORDINATES FOR SOLVING THE MACROSCOPIC EQUATIONS OF COLLISIONLESS PLASMA. Sedlacek, Z. (Inst. of Plasma Physics, Prague). Czech. J. Phys., B16: 296-313(1966).

A method is developed for the iterative solution of an infinite system of moment equations derived from the collisionless Boltzmann (Vlasov) equation. Since in a strong magnetic field the dominant terms of these equations have a complicated form, the iterative solution after a few steps comes up against difficulties connected with the inversion of matrices of high order. It is found that the transformation of moment equations into the natural "polarized" coordinate system diagonalizes the dominant matrices in the magnetic fields with straight lines of force exactly and in adiabatic magnetic fields approximately. In addition, this transformation reveals the symmetries of the moment equations which in some cases permit an exact solution to be found. Apart from the first three moment equations (the equation of continuity, the dynamic (Euler) equation, the equation for pressure) the general moment equation of the n-th order is also derived in the Cartesian and general curvilinear coordinate system and in the corresponding polarized natural coordinate systems. Some special cases of natural polarized coordinate systems belonging to a magnetic field with straight lines of force (plane, cylindrical and spherical geometry) and with curved lines of force (magnetic trap with mirrors) are treated. (auth)

26265 HIGH FREQUENCY DRIFT INSTABILITY OF A PLASMA. Mikhailovskii, A. B.; Pashitskii, E. A. (Kurchatov Inst. of Atomic Energy, USSR). Dokl. Akad. Nauk SSSR, 165: 796-9(Dec. 1, 1965). (In Russian).

The high frequency instability which can be produced in a plasma by local differences in the electron temperature is analyzed. The ratio of the Larmor radius of the ions to the characteristic dimension of the local inhomogeneity of the plasma (ρ_i/a) is not assumed small, as in earlier investigations, and the frequencies of the oscillations are assumed to exceed greatly the Larmor and the Langmuir ionic frequencies, so that the motion of the ions does not influence the oscillations. Solution of the differential equations for the electronic oscillations of such a plasma, obtained in the optical approximation, for the case of the nonuniformly heated plasma with Maxwellian electron velocity distribution function and for the case of a mixture of two Maxwellian electron plasma with two different (constant) temperatures, shows that the high frequency instability under consideration is similar to the low frequency drift instabilities investigated by various authors earlier. The stability limits of the two types of plasma are established. (ATD)

26266 EFFECT OF THE DRIFT OF IONS FROM A DISCHARGE ON THE STATE OF IMPURITY IONIZATION. Gegechkori, N. M. Dokl. Akad. Nauk SSSR, 165: 1045-7(Dec. 11, 1965). (In Russian).

The total number of atoms or ions contributing to the formation of a given line for calculating energy losses from a hot hydrogen plasma are also for evaluating electron temperatures from the intensity of individual spectral lines is considered. Drift and diffusion processes are considered as well as recombination of ions on the walls of the discharge chamber. It is assumed that the number of impurity ions and atoms in the discharge remains constant and that the rate of the drift for the ions is independent of their charge. Helium, which is weakly absorbed by the walls of the chamber was considered as an impurity. A system of equations is given which describes ionization of the helium with respect to ion drifts from the chamber for a uniform plasma with a given electron temperature and density. The problem is solved for the density of neutral atoms, singly charged and doubly charged ions. Curves are given showing the steady-state values of these densities as a function of ion lifetime as well as the time dependence of the various densities at different ion lifetimes. The results show that care should be taken in interpreting the data of spectral measurements for each specific experimental case. They also indicate that there is a theoretical possibility of determining the average lifetime of ions in terms of their drift from a discharge. (ATD)

26267 APPROXIMATION OF FREE AND BOUND CHARGES FOR A SYSTEM OF CHARGED PARTICLES, SELF-CONSISTENT EQUATIONS FOR THE SECOND DISTRIBUTION FUNCTIONS. Klimontovich, Yu. L. (Moscow State Univ.). Dokl. Akad. Nauk SSSR, 165: 1052-5(Dec. 11, 1965). (In Russian).

Equations which describe the approximation of both bound and free charges are examined. A hydrogen plasma is studied for simplicity. Similar methods may be used for analyzing more general cases. The equations derived and the corresponding equations for interacting neutral particles are used for derivation of kinetic equations for internal degrees of freedom and also for solving various problems in the theory of nonlinear polarization. (ATD)

26268 STABILITY OF A RAREFIED PLASMA IN SHORT TRAPS. Arsenin, V. V. (Moscow Engineering Physics Inst.). Dokl. Akad. Nauk SSSR, 165: 1269-72 (Dec. 21, 1965). (In Russian).

Drift and channel instability of a rarefied nonhomogeneous plasma are analyzed in a trap which is "long" with respect to ions and "short" with respect to electrons. In this case, the electron is affected by the average perturbation field with respect to the length of the trap, and the oscillation equations differ considerably from those for a system of infinite length. The idealized case where the magnetic lines of force are assumed to be straight throughout the entire length of the trap, and the trap is bounded at the ends by walls which are perfect reflectors with respect to the particles is considered. The boundary conditions for the ends are given and the characteristics which distinguish the given system from a trap of infinite

length are discussed. An equation is derived for oscillations of a plasma of given density in a metal cylinder of given radius. A solution for this equation is found which satisfies the predetermined boundary conditions. It is shown that the integral electron term has no effect on the frequency of the oscillations, and therefore that drift instability takes place in a "short" trap. This conclusion may be extended to all cases where the longitudinal and transverse electron temperatures are equal. It is found that the criterion for drift instability in the finite system coincides with that derived for the system of infinite length even when the longitudinal electron temperature is much less than the transverse temperature. Conditions for aperiodic instability in a short trap are discussed. (ATD)

26269 INTEGRATION OF THE DIFFERENTIAL EQUATION OF AN ARC COLUMN WITH ISOTHERMAL PLASMA COOLED BY THERMAL CONDUCTIVITY. Fedchenko, I. K.; Il'enko, O. S. (Kiev Polytechnic Inst.). Dopov. Akad. Nauk Ukr. RSR, No. 7, 925-9(1964).

The differential equation for the arc column is

$$-\lambda_t \frac{d^2T}{dr^2} - \lambda_t \frac{1}{r}\frac{dT}{dr} - \frac{d\lambda_t}{dT}\left(\frac{dT}{dr}\right)^2 = \gamma_t E^2$$

where T is the temperature at r distance from the axis, λ_t and γ_t the dependence of the coefficients of thermal conductivity and of electric conductivity of the plasma on temperature, and E the electric field intensity in the arc column. The integral of this equation is obtained by utilizing the principle of minimum rate of entropy increase and calculating the heat transmission by thermal conductivity. The main characteristics of the arc column were also obtained by approximate numerical solution of equation and the results were found to be in good agreement with those obtained on the basis of minimum rate of entropy increase. The agreement in the results indicates that the minimum rate of entropy increase used in determining the characteristics of the arc column is a valid method. (ATD)

26270 DISPERSION RELATIONS FOR ELECTRON PLASMA IN AN EXTERNAL MAGNETIC FIELD. Majumdar, Saroj K. (Saha Inst. of Nuclear Physics, Calcutta). Indian J. Phys., 39: 511-20(Nov. 1965).

The Boltzmann-Vlasov equation is solved by integrating it over the characteristic trajectory of the electrons. The dispersion laws for parallel and perpendicular wave propagation are obtained in terms of a function which belongs to the family of Bessel's function. Explicit expressions for this function were obtained for low temperature plasma. (auth)

26271 THEORETICAL FOUNDATIONS OF THE INDUCTION METHOD FOR MEASURING THE ELECTRICAL CONDUCTIVITY OF A STEADY PLASMA FLOW. Brunne, Marek. Inst. Maszyn Przeplyw., Prace, No. 25, 3-30 (1965). (In Polish).

An analysis of the effect that the electric conductivity of a quasi-neutral plasma jet that is coaxial with a coil in an electric circuit has on the inductance of the coil is given. The displacement currents and the drift of the lines of force with the plasma flow are neglected. A differential equation describing the phenomenon under study is derived, and a solution of this equation is obtained in general form. The changes in inductance and resistance of the coil as a function of the mean value and the distribution of the electric conductivity of the plasma are analytically defined. Respective relations are derived which consider the geometry and physical properties of the plasma and current parameters. (auth)

26272 OHM'S LAW FOR NONISOTHERMAL PLASMA WITH THERMAL DIFFUSION. Wilhelm, H. E. (Univ. of Florida, Gainesville). Contract Nonr-4104(00). J. Appl. Phys., 37: 2094-8(Apr. 1966).

Generalized Ohm's law is derived for a nonisothermal partially ionized gas under consideration of the conductive thermal diffusion effect and the thermal barodiffusion effect. Explicit expressions are given for the electrical conductivity parallel and transverse to the magnetic field and the Hall coefficient. (auth)

26273 SOME EFFICIENCY MEASUREMENTS OF THE THETA PINCH. Silberg, P. A. (Raytheon Co., Wayland, Mass.). J. Appl. Phys., 37: 2155-61(Apr. 1966).

A calorimeter technique was developed to measure the transfer efficiency of the theta-pinch in converting capacitively stored electrical energy to plasma energy. Circuit-decay measurements show that the efficient theta-pinch circuit decay consists of a two-stage circuit decay and that the inefficient theta-pinch consists of a three-stage decay. With the use of the circuit decay data, a modified transfer efficiency measurement technique was developed for a two-stage decay which is approximately as accurate as the calorimeter technique and very much quicker and easier to make. Measurements were made to evaluate the transfer efficiency of the theta-pinch in argon at pressures of 2 and 5 torr with different tube sizes and with different coupling impedances. These measurements show that within the present range of parameter values a transfer efficiency as high as 59% is possible. (auth)

26274 IRON-CORE ELECTROMAGNET PRODUCING A MAGNETIC WELL WITH NONZERO MINIMUM FOR PLASMA CONFINEMENT. Alexeff, I. (Oak Ridge National Lab., Tenn.). J. Appl. Phys., 37: 2182-4(Apr. 1966). (ORNL-P-1589).

An experimental model of an iron-core electromagnet that produces a magnetic well with a nonzero minimum was fabricated and tested for preventing plasma losses resulting from flutes or projections from the confined plasma. The advantages and disadvantages of the iron-core magnet over the air-core are pointed out. (L.B.S.)

26275 DETERMINATION OF THE PLASMA TEMPERATURE WITH THE AID OF WAVELENGTH SHIFTS OF SPECTRUM LINES. Bardocz, A.; Voeroes, T. (Univ. for Technical Sciences, Budapest). J. Quant. Spectros. Radiative Transfer, 6: 193-204(Mar.-Apr. 1966).

Using the wavelength shift $\Delta\nu$ of spectrum lines, the quadratic Stark effect, the expression $\Delta\nu = aT^2[\exp -(b/T)] \times F(T)$ with constants a and b, and the known temperature-dependent expression F(T), the temperature T in a plasma may be determined. With the aid of time-resolved spectroscopic techniques, the wavelength shifts as a function of time in a spark discharge were determined and, using the preceding formula, the temperatures were estimated as functions of time in the discharge. For the measurements, the time-resolved spark spectra of Zn, Cd, Hg, and Mg were used. (auth)

26276 SPECTROSCOPIC MEASUREMENT OF ELECTRON TEMPERATURE IN HELIUM ARC PLASMA. Ando, Kozo (Inst. of Physical and Chemical Research, Tokyo); Mori, Kazuo; Yabe, Eiji. Jap. J. Appl. Phys., 5: 341-2 (Apr. 1966).

A spectroscopic study of helium plasma produced by an energetic vacuum arc in a confining magnetic field is presented. Relative population densities in excited levels of neutral helium in the plasma were calculated from observed relative intensities of spectral lines with known oscillator strengths. The observed data for population densities of n^3D states of the helium atom are shown as a function of energy. The electron density estimated from the observed limit of the ^3D series was about 10^{13} cm^{-3} for an arc current of 100 amps. The recombination continuum was also observed under the same conditions. (J.F.P.)

26277 NONLINEAR POLARIZATION OF RADIATION PASSING THROUGH A PLASMA. Tsytovich, V. N.; Shvartsburg, A. B. (Lebedev Physics Inst., Moscow). JETP Lett. (USSR)(Engl. Transl.), 3: 65-8(Feb. 1, 1966).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Redakt., 3: 105-9(Feb. 1, 1966).

It is shown that the nonlinear interaction effects can noticeably alter the polarization of radiation passing through a plasma if the radiation has sufficient intensity or if its path in the plasma is sufficiently long. (G.O.Y.)

26278 LOW-β PLASMA EQUILIBRIUM AND STABILITY IN HELIOTRON MAGNETIC FIELD. Hayashi,

Shigenori; Oshiyama, Hiroshi (Kyoto Univ.). Kakuyugo Kenkyu (Nagoya), 16: 81-94(Feb. 1966). (In Japanese).

Equilibrium and stability problems of plasma in Heliotron magnetic fields are discussed under the assumption that the plasma behaves as hydromagnetic fluid and its pressure is much less than the magnetic pressure. When the plasma carries only a diamagnetic j_θ current and not a j_z current due to an external electric field, for instance, joule heating electric field, the plasma quantities satisfying the equilibrium conditions take some reasonable distribution. Both equilibrium plasma pressure and diamagnetic current can be expressed respectively in the forms:

$$p = \alpha_0 \frac{\psi_0}{n}\left(1 - \frac{\psi}{\psi_0}\right)^n$$

$$j_\theta = -\alpha_0 \, r \left(1 - \frac{\psi}{\psi_0}\right)^{n-1}$$

where $\psi = r A_\theta$. The condition for flute type instability is

$$\gamma p B^2 \frac{\partial}{\partial \psi}\left(\frac{1}{B^2}\right) + \frac{\partial p}{\partial \psi} > 0$$

The equilibrium state takes the form $\gamma/n > 1.51$, where γ is the ratio of the specific heats. (auth)

26279 MAGNETOSTATIC OSCILLATIONS IN INTERPENETRATING PLASMAS AND PINCHED CURRENT SHEETS. Fadeeva, V. M. Magnit. Gidrodin., No. 1, 43-6(1966). (In Russian).

Preliminary data about the unstable transverse potential oscillations in plasmas with beam anisotropy which are accompanied by an initial density modulation are presented, and an analogy with the widely known electrostatic oscillations is observed. (auth)

26280 INTERACTION OF RADIATION WITH CHARGED PARTICLES. II. DISPERSION RELATION FOR TRANSVERSE MODES. Glass, S. J. (National Bureau of Standards, Washington, D. C.); Chappell, W. R. Nuovo Cimento (10), 43B: 79-88(May 11, 1966).

The equation-of-motion technique is used to obtain dispersion relations describing the propagation of radiation in an electron gas. Dispersion relations are obtained for the case of no external field and for the case of a uniform magnetic field. (auth)

26281 DETERMINATION OF THE ELECTRON TEMPERATURE OF A CESIUM PLASMA IN A THERMOELECTRIC DIODE BY SPECTRAL METHODS. Morgulis, N. D.; Babich, I. L.; Dyadyun, Yu. A.; Kovalenko, V. P. Opt. Spektros., 18: 931-3(1965).

Spectrometric methods were used because of the difficulties of using the probe method for measuring the electron temperature in a diode with an electrode spacing of only a few millimeters. Studies of intensity distributions were made in the continuous recombination spectrum and in the bright-line radiation spectrum. In the preliminary experiments a UM-2 monochromator with photoelectric registration was used in the 4000–4944 Å wavelength range. This instrument was replaced later by a DFS-4 spectrometer with photographic and photoelectric registration, and measurements were made in the 4200–6300 Å range. The diode contained a ThC_2 cathode (directly heated to about 2000°K) and a Mo anode. The interelectrode distance was 5 mm, the contact potential distance difference, about 1.5 v, and the cesium vapor pressure, about 0.3 mm Hg. The monochromator measurements, which led to values corresponding to electron temperatures $T_e = 2500°K$, indicated a linear n_e/i dependence. The experiments made with the spectrometer showed that at $i_0 = 10$ amp/cm^2 the characteristics are similar to those of a normal arc discharge spectrum in cesium vapor. The second doublet of the principal series 4555/93 Å and the secondary series of cesium at $\lambda > 5000$ Å were clearly visible. Measurements made at $i_0 = 10$ amp/cm^2 indicated an electron temperature of 2300°K. This value did not change at $i = \frac{1}{2} i_0 = 5$ amp cm^2, the point at which the combined mechanism of thermal charge generation on the cathode and volume ionization by collisions should start acting. It is emphasized that the Maxwellian velocity distribution of the electrons and the observed uniformity of the temperatures of slow and relatively fast electrons may help to explain the nature of phenomena in discharge plasma not only in a close-spaced diode but also in the case of regular arc discharge instruments. (ATD)

26282 QUASI-LINEAR THEORY OF PLASMA WAVES. Bernstein, Ira B. (Princeton Univ., N. J. Yale Univ., New Haven); Engelmann, Folker. Phys. Fluids, 9: 937-52 (May 1966).

The quasi-linear theory of plasma waves in a collision-free plasma is formulated in such a way that corrections to the adiabatic assumption and those due to nonlinear effects can be readily estimated in terms of the properties of the initial spatially homogeneous part of the distribution function. Decaying Fourier components of the electric field are treated in a uniform way with unstable Fourier components. It is shown that the case of a three-dimensional plasma is qualitatively different from a one-dimensional plasma, the former leading to a decay to zero of the fluctuating electric field. (auth)

26283 HIGH-FREQUENCY LOSS-CONE FLUTE INSTABILITIES INHERENT TO TWO-COMPONENT PLASMAS. Pearlstein, L. D.; Rosenbluth, M. N.; Chang, D. B. (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Phys. Fluids, 9: 953-6(May 1966).

When a low-temperature homogeneous plasma is added to a high-temperature "loss-cone" limited homogeneous plasma in the presence of a uniform magnetic field, high-frequency flute-type unstable oscillations occur. For a fractional density of hot plasma (Δ) on the order of unity, the frequency and growth rates are on the order of the ion (electron) cyclotron harmonic frequency, where the harmonic number (N) is determined by the ratio of plasma to cyclotron frequency for ions (electrons). If $\Delta N \sim 1$ the instability occurs at the lower (upper) hybrid frequency. For $\Delta N \ll 1$ the instability only occurs when the ion (electron) cyclotron harmonic is equal to the lower (upper) hybrid frequency. (auth)

26284 STABILITY OF A CIRCULAR TOROIDAL PLASMA UNDER AVERAGE MAGNETIC WELL CONDITIONS. Ware, A. A.; Haas, F. A. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). Phys. Fluids, 9: 956-64(May 1966). (CLM-P-85).

The simplest closed-line-of-force plasma containment system whose average magnetic curvature is stabilizing against pressure-driven instabilities for zero β is the circular torus with small rotational transform. The energy principle is applied to the simplest case, where the rotational transform is produced by a plasma current and where r/R, B_θ/B, and $(\beta)^{1/2}$ are taken as small quantities of the same order so that an expansion procedure can be adopted. Final minimization of the energy integral leads to three simultaneous second-order differential equations, which are the toroidal equivalent of the well-known Euler equation for the linear pinch discharge. In addition to the necessary stability criterion which follows from these Euler equations, a sufficient condition shows that a β at least as high as $r^2/4R_0^2$ will be stable against both pressure-driven and $j_\parallel$-driven instabilities. (auth)

26285 MICROINSTABILITY AND SHEAR STABILIZATION OF A LOW-β, ROTATING, RESISTIVE PLASMA. Chen, Francis F. (Princeton Univ., N. J.). Phys. Fluids, 9: 965-81(May 1966).

A magnetoplasma in a radial electric field E_r suffers from a gravitational instability driven by the centrifugal force. By using only fluid equations, the theory of Rosenbluth, Krall, and Rostoker was extended to finite $k_\parallel$ and finite resistivity. The theory of resistive drift modes in cylindrical geometry is included as the limit $E_r \to 0$. The shear stabilization was computed, and it was found that the drift modes are not localized by shear unless ion Landau damping is taken into account. A stabilization criterion was obtained, which is much more severe than those found previously and which is almost impossible to fulfill experimentally. However, it is the modes with short radial wavelength that are most difficult to stabilize, and these may

not be harmful to plasma confinement. The role of the Coriolis force and the importance of these instabilities to experiments in cesium plasmas, stellarators, rotating plasmas, and beam-plasma discharges are also pointed out. This theory is particularly germane to cesium plasmas, in which it is shown that E_r cannot be ignored. (auth)

26286 EXPERIMENTAL DETERMINATION OF THE THERMAL CONDUCTIVITY OF ATMOSPHERIC ARGON PLASMA. Knopp, C. F.; Cambel, Ali Bulent (Northwestern Univ., Evanston, Ill.). Phys. Fluids, 9: 989-96 (May 1966).

The radial temperature distribution within a cylindrically symmetric argon plasma column was determined by spectroscopic analysis for arc currents of 30 to 60 A. Temperatures obtained from absolute line and absolute continuum radiation were found to be in excellent agreement. An empirical expression, based on the Kramers-Unsöld theoretical model, was obtained for the radiated power, as a function of temperature. Using the measured temperature profiles, the calculated radiated power, and an analytical expression for the electrical conductivity, the thermal conductivity of argon was determined for the temperature range of 8500 to 12000°K. The data were in good agreement with theoretically predicted results. (auth)

26287 PLASMA MOTION AND CONFINEMENT IN A TOROIDAL OCTUPOLE MAGNETIC FIELD. Dory, R. A.; Kerst, D. W.; Meade, D. M.; Wilson, W. E.; Erickson, C. W. (Univ. of Wisconsin, Madison). Phys. Fluids, 9: 997-1009(May 1966). (COO–1233-23(Rev.)).

Plasma of approximately 100 ev in ion energy was injected into and trapped within an octupole magnetic field with closed lines of force contained within a toroidal region of magnetohydrodynamic stability. A zero-field locus was near the middle of the region, and fields of 1000 to 8000 G existed along the wall and around the current-carrying hoops forming the multipole field with 4.7 to 9.6 gyroradii across the stable plasma region. Observed electric fields caused by the self polarization charge at the edge of a moving plasma cloud enabled the injected plasma stream to penetrate the octupole field and to flow rapidly throughout the low-field region. The high-polarization potentials disappeared after 100 μsec as the trapped plasma evolved into a quiescent state having typically a lifetime of 0.4 msec for 100-ev ions. The electron temperature was approximately 10 ev at all times. Density fluctuations and field fluctuations during confinement were negligibly small compared to those observed in plasmas afflicted with anomalous diffusion. Electric potential fluctuations were less than 2% of the electron temperature. This quiescent condition continued while the plasma density was smoothly decreasing by loss on probes and hoop supports. (auth)

26288 INJECTION AND TRAPPING OF PLASMA VORTEX STRUCTURES. Wells, Daniel R. (Princeton Univ., N. J.). Phys. Fluids, 9: 1010-21(May 1966).

Injection of a high density plasma into a magnetic mirror was accomplished by generating plasma vortex structures under both mirror coils. Observations indicated that the structures move toward the center of the mirror and collide. Trapped magnetic fields in the structures produced a field reversal at the center of the mirror. The collision was followed by an oscillating motion of the ring currents flowing in the highly ionized plasma. Plasma was trapped inside the mirror for times of the order of milliseconds. There was no recycling of the gas in the mirror system. The plasma thermalized and then left through the escape cones and by diffusion to the walls. The ion temperature was of the order of 200 ev. Plasma volume was approximately 1000 cm^3. Confining field was 10 kG. (auth)

26289 ROTATING PLASMA AS A SOURCE FOR INJECTION INTO A MAGNETIC MIRROR. Forsen, H. K.; Trivelpiece, A. W. (Univ. of California, Berkeley). Phys. Fluids, 9: 1022-31(May 1966).

A two-stage, magnetic-mirror, compression experiment was constructed to investigate a rotating plasma as a clean, high-temperature, plasma source. Kilovolt deuterons are created in the static, crossed electric, and magnetic fields of the first stage for transfer or injection into the second stage. It was found that the purity of the plasma is limited by electrode effects and that anomalous plasma loss occurs along the flux lines through the mirrors. These electrode effects are described and explained. The plasma loss is related to an instability associated with the anisotropic velocity distribution. (auth)

26290 NONLINEAR SCATTERING OF A LASER BEAM BY A PLASMA. Comisar, G. G. (Aerospace Corp., El Segundo, Calif.). Phys. Fluids, 9: 1037-8(May 1966).

Using a simple free-electron theory it is shown that an intense light beam can stimulate coherent electron-density fluctuations in a gaseous plasma via the $v \times B$ nonlinearity. The possibility of observing scattered light at the third harmonic of the incident beam with laser techniques is discussed. (auth)

26291 CONFINED AND NONCONFIRMED INTERCHANGE INSTABILITIES OBTAINED FROM NONLINEAR COMPUTER MODELS. Byers, J. A. (Univ. of California, Berkeley). Phys. Fluids, 9: 1038-40(May 1966).

Initial results are presented for a nonlinear computer model capable of following the nonlinear motion of low beta interchange modes. Details of the motion are shown for two widely different interchange modes. (auth)

26292 PLASMA HEATING IN STOCHASTIC ELECTRIC FIELDS. Puri, S. (Stanford Univ., Calif.). Phys. Fluids, 9: 1043-4(May 1966).

Using a "test particle" approach, it is found that an electron plasma situated in a random electric field extracts energy from the field. An initially Maxwellian distribution stays Maxwellian, and the heating rate was computed as a function of the electric field. (auth)

26293 EFFECTS OF COLLISIONS ON ELECTROSTATIC ION CYCLOTRON WAVES. Wong, A. Y.; Judd, O.; Hai, F. (Univ. of California, Los Angeles). Phys. Lett., 21: 157-9(May 1, 1966).

Quantitative measurements of the effect of $\omega\tau_{ii}$ on the frequency of maximum growth, the amplitude, and line width of electrostatic ion plasma oscillations in a magnetic field are presented. It is found that these wave characteristics change abruptly for $\omega\tau_{ii} \approx 3$. (auth)

26294 SCATTERING OF LIGHT BY A PLASMA. Nguyen-Quang-Dong (EURATOM-CEA, Fontenay-aux-Roses, France). Phys. Lett., 21: 159-60(May 1, 1966).

It is argued that experiments have invalidated rather than confirmed the theory that is usually invoked to justify or to interpret them. The spectrum of scattered light cannot be characterized by a single parameter α. (auth)

26295 ON THE PROPAGATION OF LARGE-AMPLITUDE ALFVEN WAVES. Brown, I. G.; May, R. M. (Univ. of Sydney). Phys. Lett., 21: 161-2(May 1, 1966).

A theoretical expression for the velocity of propagation of large-amplitude Alfvên, and also experimental results on the propagation of such waves (with perturbation ratios as large as 1.3) are presented. Theory and experiment are in agreement. (auth)

26296 EXPERIMENTAL EVIDENCE OF INVERSE BREMSSTRAHLUNG AND ELECTRON-IMPACT IONIZATION IN LOW-PRESSURE ARGON IONIZED BY A GIANT-PULSE LASER. Chen, Che Jen (California Inst. of Tech., Pasadena). Phys. Rev. Lett., 16: 833-5(May 9, 1966).

Experimental evidence is presented which shows that at low pressures (less than one atmosphere) most of the electrons are produced after the cessation of the laser pulse, and the ionization rise time is increased as the pressure of the gas is decreased. It is also shown that the most probable mechanism for electron production is due to inverse bremsstrahlung and subsequent electron-impact ionization. (B.G.D.)

26297 TECHNIQUE FOR SIMULTANEOUSLY MEASURING ION DENSITIES, METASTABLE ATOM DENSITIES, AND LIGHT EMISSION IN DECAYING GASEOUS PLASMAS. Sauter, G. F.; Gerber, R. A.; Oskam, H. J. (Univ. of Minnesota, Minneapolis). Rev. Sci. Instrum., 37: 572-9(May 1966).

An apparatus for simultaneously measuring the time dependence of ion densities, metastable atom densities, and the intensities of spectral lines and bands during the decay period of a gaseous plasma is described. It is comprised of a quadrupole mass spectrometer for the ion density measurements and a light spectrometer for light emission and fractional light absorption studies. The reliability of the results obtained by mass-spectrometer probing of a decaying plasma was checked by comparing the results obtained in helium with those obtained by other measuring methods. The data were found to be consistent and showed that this technique can be a significant tool for the study of collision processes occurring in decaying plasmas. Moreover, the simultaneous application of mass and light spectrometric methods gives information about the time dependences of the various plasma constituents at the same plasma region. (auth)

26298 SPATIALLY RESOLVED DENSITY MEASUREMENTS OF DEUTERIUM PLASMA USING ENERGETIC D^+ BEAM. Hickok, R. L.; Jobes, F. C.; Marshall, J. F. (Socony Mobil Oil Co., Princeton, N. J.). Rev. Sci. Instrum., 37: 591-5(May 1966).

The density distribution of cylindrically symmetric deuterium plasmas can be measured by probing the plasma with an energetic deuterium beam and observing the protons from the $D(d,p)^3T$ reaction. This technique measures the absolute deuterium density with good spatial resolution and is independent of the electron and ion velocity distributions. Using this method, the density distribution of a high-current deuterium arc was determined to within 10% for three different operating conditions. A comparison of these density distributions with optical intensity distributions shows that the optical intensity decreases faster with radius than the deuterium density. (auth)

26299 MULTISTAGE GUN FOR PRODUCTION OF LOW ENERGY ION BEAMS. Haskell, H. B. (Naval Postgraduate School, Monterey, Calif.); Heinz, O.; Lorents, D. C. Rev. Sci. Instrum., 37: 607-14(May 1966).

An ion gun using separate acceleration and deceleration stages to produce ion beams in the 1 to 100 ev energy region has been constructed and tested. The gun is based on an existing electron gun design but uses a thermal emitter $Li_2O \cdot Al_2O_3 \cdot nSiO_2$ (n = 2 and n = 4) as a source of Li^+ ions. Current densities of 10^{-8}–10^{-6} amp/cm^2 at beam energies of 2 to 100 ev were obtained, and both the spatial and the energy distributions of the ions were investigated. Minimum beam radii (typically about 1 mm) occurred a few centimeters from the last aperture. Beam profiles were measured as a function of axial distance, and well-collimated beams up to 16 cm in length were obtained. The energy spread in the beam was found to be 0.22 ev (total width at half maximum intensity), in good agreement with the expected thermal energy spread from the source which operates at about 1200°C. Mass analysis shows that beam purities are in excess of 99% $^7Li^+$ for isotopically enriched emitter material. Theoretical calculations of space charge effects on image distance and image size are presented as well as design parameters and graphs for the operation of the gun under various conditions. (auth)

26300 STRONG ION SOURCE FOR IONS FROM SOLIDS. Krimmel, Eberhard F. (Univ. of Illinois, Urbana). Rev. Sci. Instrum., 37: 678-9(May 1966). (COO-1198-323).

An ion source is described in which the solid is vaporized by electron-beam heating and the evaporated atoms are ionized by electron inpact. The ions are accelerated by an electric field to bombard a target in which the production of interstitials is desired. (D.C.W.)

26301 ELECTRIC CONDUCTIVITY OF ARGON PLASMA. Pustogarov, A. V.; Yakovlev, E. A. Teplofiz. Vysok. Temp., 3: 799-800(Sept.-Oct. 1965). (In Russian).

The electric conductivity of an argon plasma is calculated from the following expression: $\sigma = e^2 n_e \bar{\lambda}_e (m_e)^{-1} (8kT/\pi m_e)^{-0.5} = 3.78 \times 10^{-8} n_e T^{-0.5} (n_0 Q_{e0} + Q_{ei} \Sigma n_z Z^2)^{-1}$, mho/m. Here e is the electron charge; m_e is the electron mass; $\bar{\lambda}_e$ is the mean free path of the electron; k is the Boltzmann constant; n_0, n_e and n_z are the concentrations of atoms, electrons, and Z-charged ions, cm^{-3}; Q_{e0} is the effective cross section of the electron-atom interaction; Q_{ei} is the effective cross section of the electron-ion interaction in cm^2; Z is the ion charge; and T is the temperature in °K. The equation of Spitzer is used to calculate values of Q_{ei}. The calculated results are presented graphically for a pressure $p = 10^4$ n/m^2. Calculated values of the current in an argon arc are in agreement with experimental values. (TTT)

26302 EXPERIMENTAL DETERMINATION OF THE REPULSING INTERACTION POTENTIAL AND KINETIC PROPERTIES OF INERT GASES AT ELEVATED TEMPERATURES. Kamnev, A. B.; Leonas, V. B. (Moscow State Univ.). Teplofiz. Vysok. Temp., 3: 804-7(Sept.-Oct. 1965). (In Russian).

By using the methods of statistical mechanics it would be possible to calculate the high-temperature properties of gases if more information were available on repulsion potentials which are usually described in the form $v(r) = K/r^s$. Values of K and s were determined from scattering experiments with neutral particles having energies of 0.6 to 4 kev. The respective K and s values were found to be 2.8 and 3.9 for the He–He system, 78 and 7.65 for the Ne–Ne system, 171 and 6.06 for Ar–Ar, 22.6 and 5.15 for He–Ar, 10.3 and 5.61 for He–Ne, and 995 and 6.56 for the Ne–Ar system. Collision integrals were calculated and were used to estimate the viscosity, thermal conductivity and diffusion of Ne and Ar over a temperature range from 2000 to 10,000°K. (TTT)

26303 CONDUCTIVITY OF A NON ISOTHERMAL PLASMA. Shister, A. R. Teplofiz. Vysok. Temp., 3: 920-1(Nov.-Dec. 1965). (In Russian).

The conductivity of a plasma is analyzed under conditions in which the average ion displacement does not exceed the electron Larmor radius within the period of oscillation of the external electric field. Such conditions can prevail with $T_e/T_i < m_i/m_e$ and also under greater nonisothermal conditions with $T_e/T_i > m_i/m_e$. The kinetic equation is solved to determine the current density. Then an expression is given for the hermitian part of the conductivity in terms of dimensionless coefficients. An analysis of the expressions shows that if the nonisothermal conditions are sufficiently large ($T_e/T_i \sim 10^2$), the conductivity along the electric field does not depend on the frequency ω, in contrast to the usual theory. (TTT)

26304 ON THE MEASUREMENT OF ELECTRON TEMPERATURE IN HELIUM PLASMA BY THE INTENSITY RATIO OF THE SPECTRAL LINES. Kozak, O. V.; Mikhatskaya, N. A.; Pasechnik, L. L. (Inst. of Physics, Kiev). Ukr. Fiz. Zh., 11: 253-7(Mar. 1966). (In Ukrainian).

Some calculations connecting the intensity ratio of the spectral lines with the electron temperature T_e in helium plasma are presented. The calculations are carried out for different singlet (λ = 5047 Å, λ = 5016 Å, λ = 4922 Å) and triplet (λ = 4713 Å, λ = 4472 Å) combinations. The excitation function for He lines and cross section data in maxima here applied were taken as the average of results obtained previously. The electron temperature values obtained by the intensity ratio of the helium spectral lines in a positive column with hot cathode are compared with the results obtained by means of probe technique. The experimental data show that intensity ratio of some spectral lines depends upon the helium pressure when the latter is over 10^{-3} torr, which results in errors of T_e so determined. (auth)

26305 ELECTRON RECOMBINATION IN A PLASMA EXPANDING IN VACUUM. Kuznetsov, N. M.; Raizer, Yu. P. Zh. Prikl. Mekh. Tekh. Fiz., No. 4, 10-20(July-Aug. 1965). (In Russian).

In earlier theoretical work on the residual ionization of a gas expanding in vacuum, photorecombination and 3-body recombination processes occurring in a gas cloud expanding in vacuum were briefly investigated. This study is now extended and reviewed in the light of theoretical and ex-

perimental data. It is shown that, contrary to the findings of the earlier work, if the expanding gas cools rapidly, recombination does not stop, but diminishes infinitely. Because the cooling of the gas is in turn an effect of heat liberation during recombination, the process must be described by a system of equations in which kinetics and energy are related to unknown time functions. The comparison of photorecombination coefficients and recombinations due to triple collisions indicates that at excessively small electron densities, the latter collisions prevail. From then on neither photorecombination nor triple collisions (with atoms being the third particles) play any part. When the de-activation of a highly excited atom takes place rapidly when compared to the speed of the change of electron density and temperature, the recombination energy is liberated immediately after the electron capture by the ion. Only this part of the recombination energy turns into heat, which is transferred to the electrons during the de-activation of excited atoms by second-kind collisions. If the gas is transparent, the remaining part is almost completely lost. (ATD)

26306 INFLUENCE OF HALL CURRENTS DURING CONDUCTING GAS ACCELERATION IN SELF-INDUCED MAGNETIC FIELDS. Bam-Zelikovich, G. M. Zh. Prikl. Mekh. Tekh. Fiz., No. 4, 27-34(July-Aug. 1965). (In Russian).

The effect of Hall currents in the magnetic fields induced by the currents flowing in the plasma is studied theoretically in regard to their relation to plasma acceleration mechanisms. Magnetohydrodynamic equations and a generalized Ohm's law are used to obtain the solution for the flow distribution in a plasma subject to the existence of large velocities (10^7 cm/sec) so that pressure gradients can be neglected. It is assumed that no external magnetic fields and no electric fields along the length of the channel exist in the flow. The conductivity is assumed to remain constant and the product of cyclotron and collision frequencies, k, is constant. The solution is obtained by expressing the dependent variables in powers of k and all k^2 and higher power terms are neglected. The system of equations for the first order quantities is solved by quadratures for known zero order values. The flow distribution is examined in greater detail in the core of the flow and the solution for some initial and boundary conditions is given. A comparison with a previous study shows that the effect of the Hall currents is similar to that for the case with an external magnetic field. Small asymmetry relative to the axis of the channel develops when only a self-induced magnetic field is present. (ATD)

26307 NEAR-ELECTRODE LAYERS IN HOT ELECTRODES. Lyubimov, G. A. Zh. Prikl. Mekh. Tekh. Fiz., No. 4, 45-53(July-Aug. 1965). (In Russian).

A semi-empirical theory of the properties of ionized gas near hot electrode surfaces is constructed. Several models are considered for which current density, particle-velocity distribution and the Poisson equation yield the electric field near the electrodes, boundary layer thickness and current densities. The appropriate conditions are discussed under the assumption of equilibrium and the voltage-current curves are plotted. A variety of cases arises from the multitude of possible MHD concepts to which the developed theory is applied. It is shown that a choice of empirical constants is somewhat ambiguous; this leads to more than one solution, all within the experimental data. Other examples of comparison between the derived and measured voltage-current curves are given. Only a tentative comparison is made since not all parameters required by the theory were measured in all instances. (ATD)

26308 KINETICS OF THE CHEMICAL REACTIONS OCCURRING IN LOW-TEMPERATURE PLASMA STREAMS. Khait, Yu. L. Zh. Prikl. Mekh. Tekh. Fiz., No. 4, 54-65 (July-Aug. 1965). (In Russian).

One of the many problems arising in the new field of plasma chemistry is studied to shed light on auto-ignition in a plasma stream. A theoretical model is constructed where the plasma flow is subsonic and the temperature and pressure remain constant at the entrance to the reacting channel. At some distance down the channel liquids of low viscosity are introduced, with the resulting contact causing heating, boiling, evaporation, dissociation and chemical reactions. The effect of these processes on the kinetics of the system is considered for various conditions of the liquids and the characteristic lengths and time constants are given. The properties of the gas flow in the reactor influence strongly the above parameters and they are discussed with reference to heat transport, Reynolds number of the flow and the diffusion coefficients. The discussion of these processes (heating, etc.) is applied to solution of the heat equation written for the simplified problem in order to obtain estimates of the conditions and length of the period needed for self-ignition to occur. It is found that the chemical reactions have very strong influence on the hydrodynamics of the flow and lead to a Reynolds number which is a function of the coordinate. (ATD)

26309 ELECTRIC CONDUCTIVITY OF A PARTIALLY IONIZED GAS MIXTURE IN A MAGNETIC FIELD. Zhdanov, V. M. Zh. Prikl. Mekh. Tekh. Fiz., No. 4, 66-70 (July-Aug. 1965). (In Russian).

Electric conductivity of an N-component gas mixture which is partially ionized is studied by solving the diffusion equations under certain approximations. This approach permits an expression of the problem using the analogy with the three-component plasma and replacing some of the parameters with certain effective values. The linear set of vector equations for the diffusion velocities of the gas species is simplified mainly by neglecting ionic and neutral heat flows. This in turn leads to the generalized Ohm's law from which the conductivities parallel and perpendicular to the magnetic field and Hall current conductivity are obtained. Also discussed in some detail are the second-order effects in the case of weakly ionized mixtures giving a conductivity which is only slightly different from the Lorentz conductivity (assuming the same interactions.) The case of a more general degree of ionization is also discussed and a method for the computation of parallel conductivity is given. (ATD)

26310 CALCULATIONS OF A WALL-STABILIZED ELECTRIC ARC IN ARGON WITH CONSIDERATION OF RADIATIVE ENERGY TRANSFER. Vetlutskii, V. N.; Onufriev, A. T.; Sevast'yanenko, V. G. Zh. Prikl. Mekh. Tekh. Fiz., No. 4, 71-8(July-Aug. 1965). (In Russian).

The calculations of the argon arc parameters are presented with consideration of the radiation processes. The laminar arc with local thermodynamic equilibrium is considered to be stabilized by cooled walls. The electric field in the arc is taken to be constant along the axis and radially. The transport equation for the arc is solved by successive approximations. The degree of ionization is determined by Saha's equation with a lowered ionization potential. The electric conductivity and heat conductivity consisting of the heavy component conductivity, electron conductivity and conductivity due to ionization are calculated. The behavior of the radiation is considered for several kinds of transitions with special attention given to resonance lines and transitions to the ground state. The calculated parameters for the arc are tabulated for the temperature range from 6000 to 17,000°K at 1 and 10 atmosphere pressures. The radial distributions of the various components are also given. The results confirm the experimentally obtained values. (ATD)

26311 OBSERVATION OF PINCHES IN PLASMA RAIL ACCELERATORS. Grigor'ev, V. N. Zh. Prikl. Mekh. Tekh. Fiz., No. 4, 146-8(July-Aug. 1965). (In Russian).

Conditions under which narrow current layers occur in electrodynamic plasma accelerators of the rail type are discussed. The plasma is contained by a self-induced magnetic field. Conditions for the partition of current layers into pinches and processes which determine the speed of pinches, their diameter and other parameters are also considered. It is shown that the inductive deceleration of the pinches is produced by the plasma that develop behind the pinches due to the ionization of evaporated material from the electrodes and the walls of the accelerator. Spectroscopic investigations indicate that in addition to plasma

pinches in the space between the electrodes, stationary plasma with velocity less than $1.5(10)^6$ cm/sec and temperature lower than that of the pinch region and a high degree of ionization also exist. It was found that the friction of the glass walls of the vessel is negligible. Expressions are derived for the limiting velocity and radius of the pinch which agree satisfactorily with the experimental data. (ATD)

26312 MEASUREMENT OF HEAT FLOW AND ESTIMATES OF ELECTRODE TEMPERATURE IN A PULSED ELECTROMAGNETIC PLASMA ACCELERATOR. Rushailo, A. M. Zh. Prikl. Mekh. Tekh. Fiz., No. 4, 149-53 (July-Aug. 1965). (In Russian).

Heat flow to the accelerating copper electrodes during one discharge of a plasma gun is measured. The accelerator used for the tests is shown schematically. It is powered by 1480 μf bank of capacitors charged up to 5 kv. The initial pressure used is in the 10^{-4} mm Hg range. High electromagnetic fields permitted only calorimeters to be used which provided time-averaged results for the electrode material. A calorimetric radiometer with a quartz window was used for radiant energy flux. The results presented graphically show that the heat transfer to the electrodes decreased in the direction of plasma flow and again increased at the end. The energy partition between the electrodes shows uneven distribution (9 and 20% of the stored energy for 6.66 kJ discharges appeared on each of the electrodes.) A much smaller amount of energy was radiated away. The test results give a temperature estimate at the electrodes using the nonstationary heat transfer equation for a semi-infinite slab. More powerful discharges give higher wall temperatures than the melting temperature of copper. This is consistent with the observed melting of the electrode material. (ATD)

26313 DETERMINATION OF TWO-TEMPERATURE PLASMA COMPOSITION. Kraiko, A. N.; Moskvin, Yu. V. Zh. Prikl. Mekh. Tekh. Fiz., No. 4, 154-6(July-Aug. 1965). (In Russian).

The problem of the separate temperatures of the distinct components of a plasma is considered theoretically. The plasma consists of neutrals, ions and electrons and is quasineutral. Each species forms a subsystem interacting with the two others. The slowest interaction process is the energy transfer to higher states of ionization (radiation processes are neglected) and the dominating effects are the elastic collisions. It is further assumed that electron gas and the energy levels of the heavy components are in equilibrium so that electron and ion temperatures are the same. An equation analogous to Saha's equation is derived, which with the usual constraint of statistical mechanics and the pressure-temperature relation leads to a determination of the plasma state as a function of the two temperatures. The effect of departure from the stated assumptions is briefly considered. (ATD)

26314 PLASMA OSCILLATIONS WITH AN ELECTRON BEAM IN AN EXTERNAL ELECTRIC FIELD. Muratov, R. Z.; Samokhin, M. V. Zh. Prikl. Mekh. Tekh. Fiz., No. 5, 3-8(Sept.-Oct. 1965). (In Russian).

The problem of the penetration of an external electric field into a semi-infinite plasma with an electron beam having drift velocity so small relative to the main plasma that no instability develops is treated. The problem is thus a generalization of that considered by L. D. Landau (O kolebaniyakh elektronnoy plazmy. (Zh. Eksper. i Teor. Fiz., 16, 7, 574 (1946)), but may be viewed also as a boundary value problem of a weakly modulated beam interacting with a plasma. Following Landau, the problem is treated by linearization of the Vlasov-Poisson equations, from which is derived an integral equation for the linearized electric field. This is solved asymptotically, and the results are compared with those of Landau. (ATD)

26315 INVARIANT SOLUTIONS OF THE EQUATIONS OF A MULTI-COMPONENT CHARGED PARTICLE BEAM. Syrovoi, V. A. Zh. Prikl. Mekh. Tekh. Fiz., No. 5, 9-14 (Sept.-Oct. 1965). (In Russian).

An earlier work is extended to the equations describing a beam of charged particles in the presence of a stationary background of charge ρ_0 and to the case of beams of several species of particles. The basic equations are Poisson's equation and the first two moments of the Vlasov equation in the hydromagnetic approximation, neglecting pressure gradients. Using the formal group properties of the equations in plane, spherical, and cylindrical geometry, it is possible to write down time-dependent solutions corresponding to "optimal systems" of one- and two-parameter subgroups, which relate the potential φ and velocity $\underline{v}$ to an arbitrary time-dependent function. Results are tabulated and illustrated by the example of a problem with a uniform magnetic field in plane geometry. (ATD)

26316 DECAY OF LONGITUDINAL LANGMUIR PLASMA OSCILLATIONS INTO ION-ACOUSTIC WAVES. Liperovskii, V. A.; Tsytovich, V. N. Zh. Prikl. Mekh. Tekh. Fiz., No. 5, 15-22(Sept.-Oct. 1965). (In Russian).

In view of the importance of nonlinear processes arising as a result of the high intensity of oscillations excited by beam instabilities, of the interest in proposed turbulent heating schemes, and in connection with a number of other phenomena, several theoretical investigations of nonlinear plasma behavior have recently been carried out. This subject is further investigated in which several one-dimensional self-consistent problems concerning the decay or combination of Langmuir and ion-acoustic waves are considered. It is shown that instability in a turbulent spectrum with a high level of excited Langmuir waves leads to the excitation of ion-acoustic waves and to the appearance of side-bands separated by a frequency on the order of ω_{oi} from the electron plasma frequency ω_{oe}. This qualitative change in the wave spectrum may serve as a direct indication of the excitation of ion-acoustic waves in the system. (ATD)

26317 PERIODIC STRUCTURE OF STEADY-STATE RAREFIED PLASMA. Kucherov, R. Ya.; Rikenglaz, L. E. Zh. Prikl. Mekh. Tekh. Fiz., No. 5, 23-7(Sept.-Oct. 1965). (In Russian).

The criteria for obtaining a spatially periodic solution to a self-consistent rarefied plasma problem up to zeroth approximation in L(1) is studied. The plasma is assumed to be contained in a diode (no magnetic fields) with a periodic structure. (J.F.P.)

26318 FINITE-AMPLITUDE CYLINDRICAL WAVES IN RAREFIED PLASMA. Berezin, Yu. A. Zh. Prikl. Mekh. Tekh. Fiz., No. 5, 116-18(Sept.-Oct. 1965). (In Russian).

The propagation of unsteady cylindrical waves in rarefied cold plasma under a strong magnetic field is investigated. The plasma is assumed to be quasineutral, the gas dynamic pressure is neglected in comparison to the magnetic pressure, and no collisions exist between particles. At time t = 0, the uniform cylindrical plasma of radius "a" and density N is subjected to strong magnetic field H_0 directed along its axis. The resulting displacement is described by a set of five equations, three describing the plasma motion along three axes and two describing the magnetic induction. The solution is obtained numerically and the results shown graphically. The first of these depicts the propagation of magnetic disturbances along the plasma axis for small times. These exhibit an oscillatory character. The second shows the wave profiles at intermediate times. The longer the dispersion length, the larger is the oscillation. The fundamental wave front moves at the Alfven speed. (ATD)

26319 MAGNETIC FIELD TRAPPING AND PLASMA CONTAINMENT IN EXPERIMENTS WITH A COLLISIONLESS SHOCK WAVE. Iskol'dskii, A. M.; Kurtmullaev, R. Kh.; Nesterikhin, Yu. E.; Pil'skii, V. I.; Ponomarenko, A. G. Zh. Prikl. Mekh. Tekh. Fiz., No. 5, 118-20(Sept.-Oct. 1965). (In Russian).

Magnetic trapping and plasma containment were achieved in a rarefied, cylindrical, deuterium plasma by creating a collisionless shock condition. A 16-cm glass tube was placed in the centerline of a quasi-stationary magnetic field (H_0 ~0.5 kilo-oersted, T = 5 μsec). In the center of this system was added a 30-cm shock coil generating a magnetic field H ~ 3 to 6 kilo-oersteds, for T ~ 1.4 to 2 μsec. The initial plasma concentration was 5×10^{12} to

3×10^{13} cm^{-3}. Magnetic field trapping and plasma containment were achieved on the basis of the following observation. An average 40 μsec delay in neutron generation (10^6 to 10^7 neutrons), 10 kev ion-energy attainment, and bremsstrahlung radiation were obtained after the applied field H_0 had decayed. Qualitative measurements from magnetic probes indicated that the trapped field was of the order of H (coil field) with a duration commensurate with neutron generation. The trapped plasma energy was about 10 kev. (ATD)

26320 ELECTRIC CONDUCTIVITY CHANGE OF IONIZED GAS IN THE INITIAL PART OF A PLANE CHANNEL. Uflyand, Ya. S.; Chekmarev, I. B. Zh. Prikl. Mekh. Tekh. Fiz., No. 5, 120-3(Sept.-Oct. 1965). (In Russian).

The ionization process and temperature distribution in the entrance section of a plane, infinite channel ($x \geq 0$, $|y| < a$) is studied analytically. At time $t = 0$ and $x = 0$ an easily ionizable seeding gas is added to the flow at the rate $n = n_0 f(t)$ and temperature $T = T_0 g(t)$. The wall temperature at $t = 0$ is assumed to be T_0 which is the same temperature as that of the incoming gas. The governing flow equations are given by the species and energy conservation laws and the wall conduction equation. The ionization rate is governed by the Saha equation, and the electric conductivity is expressed by a simplified expression. A formal solution is obtained by using Laplace transforms. Then the analysis is simplified by assuming $f(\tau) = 1$ and $g(\tau) = m$. For the special case of $\alpha = 0$ the temperature distribution is given. It is shown that the physical properties of the channel walls do not affect the electric conductivity in the channel core. A second example is also considered where the temperature field is assumed to be oscillating with $g(\tau) = 1 + \nu \sin \omega\tau$. (ATD)

26321 DISTRIBUTION OF POTENTIAL ALONG THE ARC OF VORTEX-TYPE PLASMA GENERATORS. Dautov, G. Yu.; Dudnikov, Yu. S.; Zhukov, M. F.; Sazonov, M. I. Zh. Prikl. Mekh. Tekh. Fiz., No. 5, 132-5(Sept.-Oct. 1965). (In Russian).

The voltage-current characteristics of a plasma arc of variable length "a" were investigated experimentally under stable-arc operation conditions. The arc was vortex-stabilized and the flow was turbulent. A special flow chamber was added to the generator to control the arc pressure independently of the arc length "a." Both the cathode and the anode were made of water-cooled copper, and the working gas was air. Voltage current (U-I) curves with the arc length as the parameter showed that U decreases with decreasing arc length and that for each parameter showed that U decreases with decreasing arc length and that for each length there is a minimum in U at some value I in the vicinity of 100 amps. A voltage-versus-length curve shows that U depends on "a" linearly and varies only slightly with the main gas flow rate. On the basis of a functional analysis between U, I, mass flow rate G, and "a," the following empirical equation is obtained for predicting the potential distribution along the arc length $E = -G^{0.15}(5160 - 14.8I + 0.073I^2)6M^{-1}$ where $1900 \leq E$ (volts/m) ≤ 2500, I is in amps, and G in kg/sec. The weak dependence of U on the flow rate is explained by the fact that only a small portion of the gas is exposed directly to the arc. (ATD)

26322 ONE-DIMENSIONAL FLOW OF THERMALLY NONEQUILIBRIUM PLASMA WITH A VARIABLE DEGREE OF IONIZATION IN THE ABSENCE OF CURRENTS. Sarychev, V. M. Zh. Prikl. Mekh. Tekh. Fiz., No. 6, 18-25(Nov.-Dec. 1965). (In Russian).

One-dimensional flows of nonviscous thermal nonequilibrium plasma with a variable degree of ionization in the absence of currents are examined. The criterion of applicability for their description of ordinary gasdynamic equations is given. The expression for the velocity of sound in such a plasma is found. Under certain conditions the expression changes to the Newton formula for isothermal sound. The condition which is fulfilled in the critical section of the channel is found. It is established that weakly ionized plasma occurs at a constant electron temperature. The possible types of flow in a cylindrical channel are investigated in detail. The applicability criterion of the model of thermal equilibrium plasma and the relations which permit calculation of the flow of such a plasma in a channel of variable section are given. The flow of plasma in the absence of currents in it differs from the flow of an unionized gas. This difference is associated with the ionization and recombination processes occurring in the plasma. Electrons usually play the major role in these processes, therefore the average energies (temperatures) of the electrons and heavy particles (atoms and ions) can differ. If the frequency of inelastic collisions in plasma is small in comparison with the frequency of elastic collisions, the difference of temperatures of the electron and heavy components of the plasma can be appreciable. The simplest cases of one-dimensional flows of plasma are examined with consideration of the processes of ionization and recombination in the absence of thermal equilibrium between its components. (ATD)

26323 WAVES OF FINITE AMPLITUDE IN A HOT PLASMA. Berezin, Yu. A. Zh. Prikl. Mekh. Tekh. Fiz., No. 6, 26-32(Nov.-Dec. 1965). (In Russian).

The structure of a plane shock wave of arbitrary force propagating in a hot rarefied plasma across a magnetic field is studied. The problem of the propagation of unsteady waves of finite, but small amplitude is examined under the same conditions. Waves of finite amplitude in a cold rarefied plasma are also studied. The profile of such waves is formed under the effect of nonlinear and dispersion effects, the latter being caused by the inertia of the electrons and anisotropy of the plasma. A system of equations is used consisting of the equation of motion of the electron and ion components of plasma, the discontinuity equation, and Maxwell equations. The plasma is assumed to be quasineutral. The gas-kinetic pressure which is of a tensor nature since the distribution of ions does not have spherical symmetry is introduced into the equation of motion. (ATD)

26324 POSSIBLE SIMPLIFICATIONS OF EQUATIONS OF A TWO-TEMPERATURE PARTIALLY IONIZED PLASMA. Korovin, V. M. Zh. Prikl. Mekh. Tekh. Fiz., No. 6, 33-40(Nov.-Dec. 1965). (In Russian).

It is pointed out that in investigations of the behavior of ionized gas in electromagnetic fields frequent use is made of the equations of the conservation of mass, momentum, and energy, equations of state, Maxwell equations, and Ohm's law which yields a relation between the electric field and the current in the plasma. In a homogeneous and isotropic medium this relation reduces to a simple proportionality between current density and electric field strength, but in the general case this relation is more complex. The equations for a two-temperature plasma containing electrons, singly charged ions, and neutral atoms are simplified. The effect of viscosity and thermal forces is taken into account. The collisions of particles are considered to be elastic and it is assumed that $T_e \geq T$, where $T = T_i = T_a$. The equations of motion for each of the components are changed to the equation of motion for the mixture and two diffusion equations. The dependence of the possible forms of diffusion equations on the concentration of the medium and the parameters describing the anisotropy of the transfer coefficients are investigated. Dimensionless criteria in which Ohm's laws are appreciably simplified are described. (ATD)

26325 HYDRODYNAMIC MODELS AS APPLIED TO INVESTIGATION OF MAGNETIZED PLASMA STABILITY. Kogan, E. Ya.; Moiseev, S. S.; Oraevskii, V. N. Zh. Prikl. Mekh. Tekh. Fiz., No. 6, 41-6(Nov.-Dec. 1965). (In Russian).

MHD models are used to investigate the stability of nonhomogeneous magnetized plasma with respect to perturbations in which the electric field can be considered to be potential (curl $E \approx 0$). For studying motions across a strong magnetic field in a collision-free plasma, a hydrodynamic model is used which is a modification of the Chew-Goldberger-Low model. The total tensor of viscous dynamic model is used which is a modification of the Chew-Goldberger-Low model. The total tensor of viscous

stresses includes, in addition to "magnetic viscosity," the so-called "inertial viscosity." In the case of strong collisions the usual two-fluid hydrodynamic equations are used. It is shown that the collision viscosity causes instability of a "trough" type in the case where the "trough" mode is stabilized by a finite Larmor radius without consideration of collisions. The case where epithermal high-frequency oscillations, which do not lead directly to anomalous diffusion, cause instability at low-frequency (drift) oscillations which do lead to anomalous diffusion is also examined. (ATD)

26326 SPECTROSCOPIC STUDY OF PROPERTIES OF A SUPERSONIC PLASMA JET. Grechikhin, L. I.; Min'ko, L. Ya.; Nagornaya, N. I. Zh. Prikl. Mekh. Tekh. Fiz., No. 6, 47-52(Nov.-Dec. 1965). (In Russian).

The emission spectrum of a plasma jet at wavelengths from 3800 to 5500 Å is investigated spectroscopically. The variation of the temperature and concentration of the charged particles along the jet was measured in relation to the polarity for a shock-wave jet and a periodic-structure jet. In the spectrum of the shock-wave jet a continuous spectrum at the base of the jet the intensity of which in the direction of flow noticeably diminishes and again increases jumplike in the shock wave and then abruptly falls off is observed. In the spectrum of the periodic-structure jet there is an alternation of maxima and minima of intensities of the continuous spectrum and of the intensity of the spectral lines corresponding to compression and rarefaction points with a gradual weakening toward the end of the jet. The temperature in the plasma jet was determined by the method of relative intensities with the use of two pairs of copper lines. The temperature was measured along the jet both for the jet with a shock wave and for the jet with a periodic structure, at the base and in the rarefaction and compression zones. The results of the measurements lay along a straight line, which proves the feasibility of a Boltzmann distribution of the atoms with respect to the excited levels. The concentration of charged particles in the periodic-structure jet was higher than in the shock-wave jet. This was due to the higher temperatures and pressures in the jet. (ATD)

26327 METHOD OF GEOMETRICAL OPTICS FOR FOURTH-ORDER DIFFERENTIAL EQUATIONS RELEVANT TO LOW-FREQUENCY PLASMA OSCILLATIONS. Rukhadze, A. A.; Savodchenko, V. S.; Triger, S. A. Zh. Prikl. Mekh. Tekh. Fiz., No. 6, 58-64(Nov.-Dec. 1965). (In Russian).

A general fourth-order equation arising for small oscillations of a nonhomogeneous plasma in an external magnetic field without consideration of dissipative processes in the first approximation of geometrical optics with real coefficients is investigated. Asymptotic solutions of this equation with an accuracy up to the first-order terms are obtained and quasiclassical rules of quantization are established for various specific cases. A new vibration spectrum characteristic only for an inhomogeneous plasma in a magnetic field is determined by the theory developed. (ATD)

26328 CRITERIAL GENERALIZATION OF THE CHARACTERISTICS OF VORTEX-MODE PLASMATRONS. Dautov, G. Yu.; Zhukov, M. F. Zh. Prikl. Mekh. Tekh. Fiz., No. 6, 111-14(Nov.-Dec. 1965). (In Russian).

The criterial generalization of the volt-ampere and thermal characteristics of vortex-mode plasmatrons was previously studied. Numerous experiments have shown that the reproducibility of the volt-ampere characteristics of the arc in a plasmatron under identical, external conditions is achieved with an accuracy of ±10%. In the experiments performed the arc in a new arc chamber with clean surfaces had a higher intensity. A change in the condition of the surface as a result of the arc spot effect, as a rule, decreased the intensity. A comparison of the theoretical results with the experimental shows that the maximum deviation does not exceed ±15%. This confirms the conclusion that it is possible to achieve a generalization of volt-ampere characteristics of an arc in bicameral plasmatrons in a broad range of variations in the current, the flow rate, and the dimensions of the plasmatron. The data presented show that at the present level of knowledge on the processes in the uni- and bicameral vortex-mode plasmatrons, the method of generalization of the characteristics is an effective means for evaluation of the parameters of plasmatrons when they are being designed. (ATD)

26329 EXCITATION OF STRONG COLLISIONLESS SHOCK WAVES IN DEUTERIUM PLASMA. Iskol'dskii, A. M.; Kurtmullaev, R. Kh.; Nesterikhin, Yu. E.; Ponomarenko, A. G. Zh. Prikl. Mekh. Tekh. Fiz., No. 6, 119-21(Nov.-Dec. 1965). (In Russian).

It was previously shown that in a rarefied plasma in a quasi-stationary magnetic field shock waves can be excited with a shock front width considerably smaller than the length of the free path of the ions. Preliminary results of experiments on heating a hydrogen plasma by means of strong collisionless shock waves are presented. The methods and equipment used are described. Experimental results confirm the theory that under conditions of excitation of strong collisionless shock waves and subsequent compression of the plasma by a current layer it is possible to achieve intensive heating of the ions. Optical and magnetic measurements on the first half-period do not reveal any appreciable instabilities, which is extremely important in the clarification of the mechanism in the formation of the neutrons. The temperature of the ions, estimated in the expectation of the thermonuclear mechanism of the formation of neutrons, proved to be ~ 10 kev with $n \leq 10^{13}$ cm^{-3}, which corresponds to data obtained by means of an analyzer of charged particles by energies and magnetic probes. (ATD)

26330 METHOD FOR THE HANDLING OF MATERIAL INTRODUCED INTO THE INNER REGION OF A SHOCK WAVE SPACE, ESPECIALLY FOR CONVERSION OF THE MATERIAL INTO THE PLASMA STATE. Schmidt, Paul. German Patent 1,212,229. Mar. 10, 1966. Filed Nov. 28, 1963.

A method is described for the handling of material introduced into the inner region of a shock wave space, especially for conversion of the material into the plasma state. A substance, the atoms or molecules of which have a mean free path of less than 10^{-6} cm, is brought into the neighborhood of the center of a spherical space bounded by a hollow sphere and filled with an elastic compressible medium. Pressure shock waves are produced periodically and in quick succession in the material in the spherical space. The shock waves are in the form of spherical waves arranged concentrically with respect to the wall of the hollow sphere and progress in a radial direction towards the interior of the space meeting at the center of the hollow sphere. (Gmelin Inst.)

26331 RADIALLY CONVERGING FUSION REACTOR. Hansen, Siegfried; Bonardi, Giusto Fonda (to Litton Systems, Inc.). U. S. Patent 3,243,348. Mar. 29, 1966. Filed May 2, 1963.

A nuclear fusion reactor comprises a chamber, means for placing a plasma in the chamber, and means for conforming the plasma to a toroid. The means for conforming the plasma includes at least one group of nested annular coils with means for applying electric signals sequentially to the coils for imparting a radially inward force to the plasma along the plane of the toroid and for converging oppositely disposed particles in the plasma at a preselected point in the chamber with sufficient velocity to fuse. (B.L.M.)

26332 PLASMA ACCELERATOR USING HALL CURRENTS. Cann, Gordon L. (to Electro-Optical Systems, Inc.). U. S. Patent 3,243,954. Apr. 5, 1966. Filed Aug. 17, 1962.

A plasma accelerator is described in which a partially ionized gas stream is produced, the jet is accelerated to supersonic velocities through a nozzle, and the jet is accelerated through axisymmetric fringe magnetic fields and a secondary electric discharge extending axially downstream throughout the length of the fringe magnetic fields. Tangential Hall currents are generated by the current density lines crossing the magnetic field lines, and these currents then interact with the radial components of the

magnetic field to impart axial acceleration to the gas. The Hall electric field is effectively eliminated due to the impossibility of maintaining a tangential electric field. In the accelerating discharge, the electrons are forced to spiral due to the radial component of the applied fringe magnetic field. The rotational force applied to the electrons upon their entry into the fringe field is directly opposite to the force applied to them upon their exit. The rotational forces cancel each other leaving only the axial Hall force to accelerate the jet of gas. By the establishment of a series of separate axisymmetric magnetic fringe fields along the discharge path greater exhaust velocities can be achieved, since the jet is accelerated by the axial Hall force created in each field. (B.L.M.)

Shielding

Refer also to abstract 26064.

26333 (CONF-660303-2) PREPARATION OF EVALUATED CROSS SECTION LIBRARIES. Lubitz, Cecil R. (Knolls Atomic Power Lab., Schenectady, N. Y.). [nd]. Contract W-31-109-eng-52. 14p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From American Physical Society, Conference of Neutron Cross Section Technology, Washington, D. C.

The process of putting together a library of neutron cross sections for use in reactor and shielding calculations is discussed. A modular, user-oriented, automated data handling and computational system designed for a high-speed computer is briefly described. The theoretical methods used for interpolation and extrapolation of experimental results are discussed, as well as the problems associated with feeding back experimental information into our libraries. A number of problems concerning the status of cross section measurements and the methods of reporting them are enumerated, emphasizing those experimental points of particular importance in the evaluation process. (auth)

26334 (DC-60-4-87) PROPOSED TWO-COMPONENT METHOD OF NUCLEAR SHIELD ANALYSIS. Moteff, J. (General Electric Co., Cincinnati, Ohio. Aircraft Nuclear Propulsion Dept.). Apr. 13, 1960. Contract AT(11-1)-171. 29p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

When broad beam removal cross sections are used in the conventional Albert-Welton IBM shielding programs a certain fast neutron dose rate will be obtained for the 50-foot position. Assuming a dose rate uncertainty factor of ±2 the side shield material weight for the ACS P140 power plant can be given as 10.620 ± 13.6% pounds. If the Albert-Welton IBM shielding program is slightly modified to use collimated removal cross sections; and the analysis also includes the dose contribution from the surface of the shield a lower dose rate is obtained for the 50-foot position. This new dose rate indicates that the side shield material weight can be given as 7850 ± 9.5% pounds if the original neutron dose rates are desired. Although the neutron dose rates are changed by large factors for the LiH thicknesses considered, the gamma dose rates are only changed by about 30%. This side shield gamma increase would not change the crew shield dose rate by more than a few percent. An alternate performance gain would be to reduce the crew shield weight, which for a nearly optimum design would result in an equivalent weight savings. A two component shield analysis method is proposed and compared to existing experimental data. The significance of the neutron spectrum is also discussed. (auth)

26335 RADIATION FIELD OF A DISK SOURCE IN A HOMOGENEOUS ABSORBING HALF-SPACE. Schultz, H.; Wueneke, C.-D. (Technische Hochschule, Hanover). Atomkernenergie, 11: 247-50(May-June 1966). (In German).

Using a suitable model, the penetration of monoenergetic gamma rays or fast neutrons, emerging from a disk source, into a homogeneous medium was calculated. Using an electronic computer comprehensive with mockup experiments for reactor shielding an approximative procedure was developed and suitable nomograms are given, allowing a quick survey of the radiation field. (auth)

26336 SCATTERING OF GAMMA RADIATION FROM SEMI-INFINITE SLABS. Hendee, W. R.; Ellis, J. L. (Oak Ridge National Lab., Tenn.). Health Phys., 12: 673-81(May 1966). (ORNL-P-1529).

Experimental measurements were made of the exposure due to ^{60}Co and ^{137}Cs gamma rays scattered from thick, semi-infinite slabs of concrete, lead and water, for various separation distances between source and detector and for various heights of source and detector above the scattering slabs. The results indicate that the ratio of source and detector height above the scattering slab to the distance of separation of source and detector is the parameter most influential in determining the scattered exposure. No influence on the scattered exposure was observed by positioning the source at a height greater or lesser than that of the detector. Isotropic reflection curves closely approximating the experimental points were obtained from albedo calculations and resulted in energy albedos of 0.050, 0.0113 and 0.049 for ^{60}Co radiation on concrete, lead and water, respectively, and of 0.100, 0.013 and 0.083 for ^{137}Cs radiation on concrete, lead and water, respectively. (auth)

26337 ECONOMICAL MASSIVE SHIELD FOR GAMMA SPECTROSCOPY. Rozzell, T. C.; Setser, J. L.; Logsdon, G. S. (Taft Sanitary Engineering Center, Cincinnati). Health Phys., 12: 699-703(May 1966).

A large shield for gamma spectroscopy was designed and assembled. The cost was approximately one-fifth that of a commercial shield. This cubically shaped shield has 2-in. lead walls, with inside dimensions of 22 in. per side. It is lined with $\frac{1}{16}$-in. copper to reduce the low energy x rays resulting from photoelectric interactions within the lead. A steel frame and steel rods support the 117 various size lead bricks. It was necessary that costs and weight be kept as low as possible. The total cost was $757.00 and the weight is 3100 lb (including 48- by 36- by $\frac{1}{2}$-in. steel plate on which the shield rests). The shield previously used was a popular 3-in. (1000 lb) lead module type. The Compton backscatter and low energy lead x rays were significantly reduced by the new shield, and the resolution in the lower energy region was also improved. The large shield also permits the analysis of larger samples. (auth)

26338 DOSE BUILDUP FACTORS OF PLANE PARALLEL BARRIERS FOR ^{60}Co PLANE MONODIRECTIONAL SOURCE. Furuta, Yutaka; Tsuruo, Akira; Miyasaki, Shun-ichi; Tamura, Kozo; Kanemori, Yoshihiko Nucl. Sci. Eng., 25: 85-92(1966).

Dose-buildup factors for a plane monodirectional source of ^{60}Co were obtained experimentally for plane parallel barriers composed, respectively, of water, graphite, ordinary glass, aluminum, ordinary concrete, heavy concrete, iron, and lead. For water, aluminum, ordinary concrete, iron, and lead, comparisons were made between the experimental and the theoretical values that were calculated by a method to obtain dose buildup factors of finite barriers. The results showed these values to be in good agreement for all materials except water. For water, further calculation by the Monte Carlo method supported the theoretical value. (auth)

26339 OPTIMUM SHAPE OF POLYCHROMATIC GAMMA-RADIATION SHIELDS. Tsvetkov, V. I. Zh. Prikl. Mekh. Tekh. Fiz., No. 6, 10-17(Nov.-Dec. 1965). (In Russian).

The establishment of an optimum shape of shields (in the sense of a minimum weight) for the case of monoenergetic gamma radiation from point, disk, and cylindrical sources was previously discussed. The same problem for the same source geometries for the case of polychromatic gamma radiation is solved. The scattering of radiation to the surrounding medium is neglected, and the source emission is assumed isotropic. The multiple scattering within the shields is taken into account by analytical expressions for the accumulation factor. In addition to the formulas for optimum shield-shapes, the

author suggests means for the determination of the weight of the shield. (ATD)

Solid State Physics

See also CHEMISTRY — Inorganic and Physical Chemistry
METALS, CERAMICS, AND OTHER MATERIALS — Properties and Structure

Refer also to abstracts 26020, 26075, and 26196.

26340 (AD-631987) CRYSTAL CHEMISTRY STUDIES. Third Quarterly Report, November 14, 1965–February 13, 1966. Roy, Rustum; McCarthy, G. J.; Muller, O.; White, W. B. (Pennsylvania State Univ., University Park. Materials Research Lab.). Apr. 1966. Contract DA28-043-AMC-01304(E). 7p. CFSTI $1.00 cy, $0.50 mn.

Studies were made on the characterization of the rare-earth-rhenium compounds and a new compound of samarium. Precise unit cell data are reported for Yb_2ReO_5, Er_2ReO_5, and Dy_2ReO_5. Nd_2ReO_5 is polymorphic and cell data for both forms are reported. The results of a large sequence of experiments are reported in which compound formation was sought between ReO_2 and MgO, CdO, Sb_2O_3, Al_2O_3, Cr_2O_3, and Fe_2O_3. The samarium compound tentatively identified as Sm_3O_4 is now thought to be a silicate $2\ Sm_2O_3 \cdot SiO_2$. (auth)

26341 (CEA-Bib-67) ETUDE DES DEFAUTS CRISTALLINS AU MOYEN DE LA RESONANCE DES NOYAUX VOISINS. (Study of Crystalline Defects by Means of the Resonance of Adjacent Nuclei). Minier-Cassayre, Colette (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Dec. 1965. 28p. Dep. mn.

The phenomena of nuclear resonance can give information on the structure of crystalline defects, on their mobilities and interactions. The effect of defects on dipolar resonance is reviewed, in particular, the modification of the Knight shift; the analysis of phenomena in ferromagnetic material and variations of relaxation time T_1. The effect of crystalline defects on the quadrupole interaction in a strong magnetic field and after in zero field was investigated. (auth)

26342 (CEA-R-2821) ETUDE A TEMPERATURE FINIE D'UN SYSTEME D'ONDES DE SPIN EN INTERACTION DANS UNE APPROXIMATION SELF-CONSISTANTE [Theses]. (Self-Consistent Treatment of Interacting Spin Waves at Finite Temperatures [Thesis]). Bloch, Micheline (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 1966. 82p. Dep. mn.

Submitted to Paris Univ. (France). Faculte des Sciences.

A spin wave theory is developed where account is taken of spin wave interactions at finite temperatures. The temperature dependence of the spin wave energies and of the magnetization is derived. The theory is developed for ferro-, ferri-, and antiferromagnets. (auth)

26343 (IS-T-77) MICROWAVE HALL MOBILITIES OF HOLES IN GERMANIUM [Thesis]. Ho, Bou-loong (Ames Lab., Iowa State Univ. of Science and Tech.). Feb. 1966. Contract W-7405-eng-82. 68p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

Hall mobilities of three p-type germanium crystals were measured at microwave frequencies of 9.5 G Hz from room temperature to near liquid helium temperatures by means of a newly designed bimodal rectangular cavity. The microwave Hall mobilities were compared with the corresponding d-c Hall mobilities. As the temperature was decreased, the microwave Hall mobility began to deviate from the d-c Hall mobility at about 200°K for each of the less pure samples 439GP and GPl, but not until 150°K for the purest sample 439HGP. The difference between the microwave and d-c Hall mobilities at low temperatures was greater in the order 439GP > GPl > 439HGP, whereas the purity of the samples followed the opposite order 439HGP > GPl > 439GP. The difference between the microwave and d-c Hall mobilities can be explained in terms of a high frequency inertial effect in which the relaxation time depends upon scattering of the holes by impurities as well as by phonons. This inertial effect accounts for the experimental results: one, at low temperatures, the microwave Hall mobility was always lower than the corresponding d-c Hall mobility; and two, an increase in impurity scattering always increased the difference between the microwave and d-c mobilities of the holes. (auth)

26344 (N-65-34948) OPTICAL PROPERTIES OF TRANSITION IONS IN CRYSTALS UNDER BOMBARDMENT BY ENERGETIC PARTICLES, X AND GAMMA RAYS, AND LIGHT. Final Report. Carlson, Edward H. (Alabama Univ., University. Dept. of Physics). Sept. 15, 1965. Contract NAS8-11200. 8p. (NASA-CR-67205). CFSTI $1.00 cy, $0.50 mn.

Studied were radiationless processes and their effects on the lifetimes of the radiating states of crystals containing rare earth ions after excitation by flash lamp. Time-resolved spectroscopy of the fluorescent intensity by pulsed photomultiplier detector was used to obtain life rise times for Sm^{2+}, and fall lifetimes for $Pr^{3+}:LaCl_3$, $Nd^{3+}:LaCl_3$, and $Sm^{2+}:LaCl_3$ at 77 and 4.2°K. Also determined was the excitation spectrum of Sm^{2+}. Temperature measurements on the $Sm^{2+}:LaCl_3$ lifetimes found a striking dependence which indicates a multiphonon process. At 4.2°K, no initial rise in fluorescence intensity as a function of time after the flash could be seen, and decay lifetimes were 10 msec, and 2 msec for the A and B levels, respectively. At 77°K, the fluorescence from A showed an initial rise with a lifetime of 50μsec and a decay of 3.5 msec. The B level showed only a decay time of 2.1 msec. (STAR)

26345 (NP-16010) LECTURES ON SOLID AND LIQUID STATE PHYSICS. (Atomic Energy Establishment, Trombay (India)). 1965. 89p. Dep. mn.

Separate abstracts are prepared for the 4 included lectures. (M.O.W.)

For abstracts of individual papers see: 26346–26349.

26346 (NP-16010, pp 1-41) ELASTIC DIFFUSE SCATTERING OF NEUTRONS BY DILUTE FERROMAGNETIC ALLOYS. Low, G. G. (Atomic Energy Research Establishment, Harwell (England)).

The kinds of measurements that can be carried out in connection with magnetic systems using the diffuse scattering of neutrons are discussed. Scattering cross sections of ferromagnetic alloys containing impurities were discussed. The base alloys considered were nickel, iron, and palladium. A theoretical analysis along with experimental results is presented. (M.O.W.)

26347 (NP-16010, pp 42-101) DYNAMICS OF CRYSTAL LATTICES. Cochran, W. (Edinburgh Univ., Scotland)).

Crystal lattice dynamics are discussed with the aid of the shell model. The Born-von Karman theory is reviewed and used in conjunction with the shell model to describe the vibrational aspects of ionic crystal and diamond lattices. (M.O.W.)

26348 (NP-16010, pp 102-39) CO-OPERATIVE MODES OF MOTION IN LIQUID METALS. Egelstaff, P. A. (Atomic Energy Research Establishment, Harwell (England)).

A theory is developed for coherent neutron scattering. Neutron spectra measurements were obtained for silica, vanadium, liquid sodium, liquid tin, methyl alcohol, and liquid lead at various scattering angles. The results are discussed in detail. (M.O.W.)

26349 (NP-16010, pp 140-77) THEORY OF NEUTRON SCATTERING FROM LIQUIDS. Singwi, K. S. (Argonne National Lab., Ill.).

General aspects of the problem of line shapes are discussed from stochastic considerations. Neutron scattering line shapes are discussed for the case of coherent scattering. Results of scattering calculations for argon are discussed. (M.O.W.)

26350 (STI-DOC-10/50) APPLICATIONS OF THE MOESSBAUER EFFECT IN CHEMISTRY AND SOLID-STATE PHYSICS. Technical Reports Series No. 50. Report of a Panel Held in Vienna, 26-30 April 1965. (International Atomic Energy Agency, Vienna (Austria)). 1966. 270p. (CONF-650425). IAEA: $6.00; S126,-; £ 1.16.0; F Fr 24,-; DM 21,-.

Separate abstracts were prepared for 18 of the 30 papers included. Four papers dealing with the influence of aprotic solvents on the quadrupole splitting of the Moessbauer spectral lines of dibutyltin chloride, the isomeric de-excitation in ^{119m}Sn, the lifetime of nonequilibrium Fe^{3+} ions in some ionic solids, and magnetic fields on nuclei of diamagnetic atoms are included in abstract form only. Five of the remaining papers can be found under abstract numbers 19: 26384, 38025, 39863, 40078, and 20: 3136. The other three papers can be found under CONF-650425 in the report number index. (D.C.W.)

For abstracts of individual papers see: 25088, 25089, 25188, 25359, 25425, 25597, 26193–26197, and 26379–26385.

26351 (UCRL-16777) FIELD ION MICROSCOPE STUDIES OF INTERFACES. Ranganathan, S. (Lawrence Radiation Lab., Univ. of California, Berkeley). Mar. 1966. Contract W-7405-eng-48. 36p. (CONF-660317-1). Dep. mn. CFSTI $2.00 cy, $0.50 mn.

From Field Ion Microscopy Conference, Gainesville, Fla.

Field ion microscope studies were made on boundaries separating crystals differing only in orientation. Observation of boundaries separating crystals differing in structure and composition is also discussed. Direct evidence for the presence of dislocations at grain boundaries is given and analyzed. Field ion micrographs of high angle grain boundaries showed three types of structures. (P.C.H.)

26352 MADELUNG CONSTANTS. Hoppe, R. (Univ., Giessen, Ger.). Angew. Chem. Int. Ed. Engl., 5: 95-106 (Jan. 1966).

Madelung constants, simple numbers which depend on the type of structure investigated, are needed for calculation (using the Born-Haber cycle) of lattice energies and enthalpies of formation of ionic compounds. Each Madelung constant is the sum of partial Madelung constants which represent the contributions of the individual ions to the total lattice energy. The partial Madelung constants (PMF) depend on the ionic charge and, clearly though not stringently, on the coordination number. On the other hand, each Madelung constant can be represented by a sum of Madelung constants for related simple primitive AB structures. These Madelung constants are numerically interrelated in a simple manner, and are related to the partial Madelung constants of interstitial sites. Madelung constants of parameter-dependent structures (e.g., of the rutile or anatase type) and their variations with the structure-determining quantities are of particular interest. Madelung constants also yield information in the case of complex compounds and of nonmetal compounds (e.g., XeF_2, XeF_4, $XeF_2 \cdot XeF_4$). Data for XeF_4 are compared with those for SiF_4, and it is shown that the $PMF(F^-)$ values for XeF_4 are smaller than those for SiF_4. The reason is the electrostatically unfavorable planar shape of the XeF_4 unit. The smaller value of $PMF(Si^{4+})$ as compared with $PMF(Xe^{4+})$ indicates the closer bonding of the XeF_4 groups. From the heats of sublimation (SiF_4: 6.15 kcal/mole, XeF_4: 15.3 kcal/mole) the Madelung constant of the XeF_4 type would be expected to be larger than that of the SiF_4 type. (BBB)

26353 MAGNETORESISTANCE AND SCATTERING ANISOTROPY IN γ-IRRADIATED n-TYPE GERMANIUM. Swenson, Goesta (Chalmers Univ. of Tech., Goteborg). Ark. Fys., 32: 555-65(1966).

The effect of gamma irradiation at room temperature on the weak field magnetoresistance in Ge was studied in the temperature range 77 to 300°K. The anisotropy parameter $K = (m_{\parallel}/m_{\perp})$ was obtained from the galvanomagnetic measurements by a method suggested by Broudy and Venables. The defects which are introduced by the gamma irradiation were found to increase the K value below 200°K. This means that the scattering anisotropy decreases after irradiation. A possible explanation of this result is discussed in terms of interaction between positive donors and negative primary defects. (auth)

26354 ANNEALING EXPERIMENTS ON ^{60}Co-GAMMA IRRADIATED GERMANIUM. Henriksson, Bo (Chalmers Univ. of Tech., Goteborg). Ark. Fys., 32: 167-77(1966).

Annealing behavior of ^{60}Co-gamma irradiated 10.5 ohm-cm antimony-doped germanium was studied utilizing minority carrier lifetime measurements. Three samples with different dislocation densities are presented. The sample with the highest dislocation density did not show trapping but the other samples did. The results give a recombination level located 0.36 ev and a trapping level located 0.26 ev above the valence band. The latter level is attributed to a vacancy. The annealing behaviors of recombination centers and of trapping centers are strongly dependent on dislocation density indicating that the responsible defects have dislocation density dependent activation energies. (auth)

26355 ON THE MOTION OF α-PARTICLE IN A CRYSTAL LATTICE STUDIED BY MEANS OF A MONOCRYSTALLINE α-SOURCE. Domeij, Bo (Research Inst. for Physics, Stockholm. Royal Inst. of Tech., Stockholm). Ark. Fys., 32: 179-200(1966).

^{222}Rn ions were injected into a W single crystal cut perpendicular to the (111) axis. The injection energy was varied between 5 and 450 kev. The intensity of the α particles emitted in the decay of ^{222}Rn was measured as a function of angle between the crystal normal and the direction to the detector. It was found that the intensity had pronounced minima for angles corresponding to major directions and planes in the crystal. The effect is explained in terms of the string theory by Lindhard and it was found that the width of the minima agreed reasonably well with the theoretical predictions. The influence on the intensity variation by different perturbations such as damage caused by the incoming Rn ion, surface contamination, ion energy and temperature is discussed. The result shows unambiguously that the majority of the injected Rn ions are located in lattice positions. (auth)

26356 CRYSTAL STRUCTURE OF THE SIMPLEST La AND Sm SILICATES. Kuz'min, E. A.; Belov, N. V. (Gor'kii State Univ., USSR). Dokl. Akad. Nauk SSSR, 165: 88-90(Nov. 1, 1965). (In Russian).

Synthesized single-crystal crystal chips of the compounds $La_2O_3 \cdot SiO_2$, $La_2O_3 \cdot 2SiO_2$, $Sm_2O_3 \cdot SiO_2$, and $Sm_2O_3 \cdot 2SiO_2$ were structurally analyzed by x-ray diffraction. The unit cells of the hypothetical compounds $La_2O_3 \cdot SiO_2$ and $La_2O_3 \cdot 2SiO_2$ were found to be completely identical, indicating that these compounds are identical; the same applied to the Sm silicates. Powder patterns of the La and Sm silicates were strikingly similar to those of britholite, a structural analog of apatite. The atomic coordinates and interatomic distances of the two silicates were determined. The existence of compounds of the composition $La(Sm)_{4.67}[SiO_4]_3O$ was confirmed. (ATD)

26357 MAGNETIC MOMENTS AND FIELDS ON NUCLEI OF FERROMAGNETIC ATOMS. Gal'perin, F. M. Dokl. Akad. Nauk SSSR, 165: 1041-4(Dec. 11, 1965). (In Russian).

The magnetic moment and field on the nucleus of an atom are shown to be associated with the crystal structure of a ferromagnetic material and that this relationship may be used to explain a number of important phenomena. The distances between an atom and its closest neighbor in the crystal structure of transition elements in the iron group are compared with the average radii of the 3d-shells in the atoms. For this purpose, the characteristic interatomic distance R ($R = 0.13\,[(C/2)^2 - 5.75C + 51]$ for $C \geq 8$ and $R = 0.13\,[(C/2)^2 - 4.75C + 43]$ for $C \leq 8$) is presented where C is the electron concentration (the total number of 3d- and 4s-electrons) in an isolated atom. The parameters p_a and $\bar{p}$ for binary

unordered paramagnetic alloys ($p_a = 0.64\Sigma n_i(r_i - R_a)/\bar{A}$ and $\bar{p} = 0.64\Sigma n_i(r_i - \bar{R})/\bar{A}$) are presented where n_i is the number of atomic neighbors; i = 1 for closest neighbors; i = 2 for next closest neighbors; c_a is the atomic concentration of the component in the alloy, $\bar{R} = c_aR_a + c_bR_b$. A table is given showing A-moments and the parameter p for pure transition elements in the iron group. These data show that for all transition elements, except nickel, $p < 0$ while for nickel $p > 0$. A formula is given for the localized atomic magnetic moment in Bohr magnetons. Tables are given showing the A-moments for iron in iron–nickel and iron–chromium alloys as well as the magnetic moments and fields on the nuclei of atoms in solid solutions. A critical concentration is observed for both systems of alloys when the magnetic moment of the b-metal (Fe in the first alloy and Cr in the second) reverses its orientation. A formula is given for the effective magnetic field on the a-atom of Fe–Ni and Fe–Cr solid solutions. Experimental data show that the effective magnetic field on the nucleus of an iron atom in nickel is less than 300,000 oersteds, while the effective field on the nucleus of an iron atom in cobalt is greater than 300,000 oersteds. Extrapolation of the linear sections of curves for nickel and cobalt concentration as a function of the effective magnetic field to 100 at.% Fe gives an effective magnetic field of 360,000 oersteds which is close to the theoretical value on the nuclei of cobalt and nickel atoms dissolved in iron. (ATD)

26358 DOSE-RATE EFFECT IN PHOSPHORESCENCE AND THERMOLUMINESCENCE. Facey, Robert A. (Defence Chemical Biological and Radiation Labs., Ottawa). Health Phys., 12: 715-17(May 1960.

The dependence of phosphorescence decay of the dose rate for certain thermoluminescent dosimeter systems was demonstrated using magnesium-activated calcium sulfate phosphors. It is pointed out that while the dose-rate dependence is important for phosphorescence it tends to be a minor effect for thermoluminescence. (L.B.S.)

26359 HEATING-RATE EFFECTS IN GLOW PEAK MEASUREMENTS FOR THERMOLUMINESCENCE DOSIMETRY. Facey, Robert A. (Defence Chemical Biological and Radiation Labs., Ottawa). Health Phys., 12: 717-20 (May 1966).

An experimental investigation was made to show the importance of specifying heating rates when reporting glow curves or glow-peak temperatures in thermoluminescence studies. The glow-peak temperature of finely powdered $CaSO_4$ was shown to vary from about 100° to 160°C by change of heating rate. At around 1000°C/min in 20–30 mg samples in N_2, the contribution of thermal lag to elevation of the peak temperature was found not to exceed 10°C. It was also found that a helium atmosphere is of value in minimizing thermal lag. (L.B.S.)

26360 DYNAMICAL BEHAVIOR OF EXCHANGE-COUPLED SPINS. Erdoes, Paul (International Business Machines Corp., Zurich). Helv. Phys. Acta, 39: 155-63 (1966).

The magnetic resonance conditions and dynamic susceptibilities of a two-spin system are derived. The spins are coupled through a combination of isotropic and asymmetric exchanges. This type of interaction occurs in weak ferromagnets. A method is developed which permits the summation of the perturbative series for the wave function in the case of resonance. (auth)

26361 GENERATION-RECOMBINATION NOISE IN Ge SINGLE CRYSTALS UNDER FAST-NEUTRON IRRADIATION. Bilger, H. R.; McCarter, E. R. (Oklahoma State Univ., Stillwater). J. Appl. Phys., 37: 1978-82(Apr. 1966).

Experimental results are reported on the Fourier spectra of generation-recombination (g-r) noise of Ge single crystals, using a reversible technique to vary the noise parameters. Namely, a comparison is made with the noise before irradiation, after irradiation with 14.7-Mev neutrons, and after annealing. Reasonable agreement was obtained with the theory based on a three-level recombination with a single (Shockley-Read) level in the forbidden band. (auth)

26362 GROWTH OF LASER-QUALITY RARE-EARTH FLUORIDE SINGLE CRYSTALS IN A DYNAMIC HYDROGEN FLUORIDE ATMOSPHERE. Robinson, M.; Cripe, D. M. (Hughes Aircraft Co., Malibu, Calif.). J. Appl. Phys., 37: 2072-4(Apr. 1966).

Very high optical quality single crystals of LaF_3, CeF_3, PrF_3, and NdF_3 were grown. With a multiport graphite crucible, as many as six crystals were prepared in a single experiment. The crystals were grown in a dynamic helium–hydrogen fluoride atmosphere in a modified Stockbarger-type furnace. Ion exchange purification methods resulted in LaF_3 crystals transparent to 0.14μ. (auth)

26363 EFFECT OF PRESSURE ON THE CURIE TEMPERATURE AND VOLUME OF GdN. McWhan, D. B. (Bell Telephone Labs., Inc., Murray Hill, N. J.). J. Chem. Phys., 44: 3528-30(May 1, 1966).

The change in the Curie temperature of GdN with pressure was measured up to 100 kbar by a transformer method and is given by $dT_c/dP = +0.08° \pm 0.04°K/kbar$. The compressibility was determined relative to NaCl by powder x-ray-diffraction methods and can be expressed by a Birch equation with $B_0 = 1920 \pm 350$ kbar and $\xi = 0$. The results are compared with EuO: $(d \log T_c/d \log V) = -2.2 \pm 1.5$ for GdN and -5.5 ± 1.5 for EuO. This difference results from the combined effect of the valence difference between the compounds and a difference in the exchange mechanism. (auth)

26364 EFFECT OF GAMMA IRRADIATION ON MINORITY CARRIER LIFETIME IN GERMANIUM SINGLE CRYSTALS. Fukuoka, Noboru; Hirata, Mitsuji; Saito, Haruo (Osaka Univ.). Jap. J. Appl. Phys., 5: 383-8 (May 1966).

Arsenic- and antimony-doped germanium were irradiated by ^{60}Co gamma rays at −72°C. Changes in the minority carrier lifetime were studied as a function of time and temperature for various periods after the irradiations. The formation of traps was observed in arsenic-doped crystals after irradiation. The position of the trapping level was found to be 0.18 ev from the valence band. In antimony-doped crystals, the formation of traps was detected only in a heavily doped sample. The trapping center was stable or rather increased in arsenic-doped crystals on annealing at room temperature. A little reverse annealing was observed in the range of room temperature both in arsenic- and antimony-doped samples. (auth)

26365 SCATTERING OF COLD NEUTRONS IN IRRADIATED KBr AND NaCl CRYSTALS. Andronikashvili, E. L.; Bedbenova, D. S.; Politov, N. G.; Tsakadze, D. S. (Physics Inst., Academy of Sciences, Georgian SSR). JETP Lett. (USSR)(Engl. Transl.), 3: 110-12(Feb. 15, 1966).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Redakt., 3: 173-7(Feb. 15, 1966).

The scattering of cold neutrons by single crystals of KBr and NaCl was studied both before and after exposure of the crystals to gamma radiation. The scattering of neutrons by defects was observed. It was found that the observed change in neutron transmission can not be explained in terms of the concentration of F and M centers. (D.C.W.)

26366 TRANSITION RADIATION OF NONRELATIVISTIC ELECTRONS IN THIN ALUMINUM FILMS. Arutyunyan, F. R.; Petrosyan, Sh. V.; Oganesyan, R. A. (Physics Inst., Erevan). JETP Lett. (USSR)(Engl. Transl.), 3: 123-5(Mar. 1, 1966).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Redakt., 3: 193-7(Mar. 1, 1966).

The radiation produced when an electron beam with energy up to 60 kev passes perpendicular to the surface through thin aluminum films was investigated in the wavelength interval from 3480 to 5500 Å at angles from 0 to 90° relative to the electron motion. The radiation was analyzed using polarization and interference filters. The radiation

was found to be polarized in the radiation plane, and its degree of polarization reached 98%. The results show a linear dependence of the radiation intensity on $\sin^2\theta$, where θ is the angle between the transmission plane of the polarization filter and the radiation zone. The spectral distributions of the radiation, the angular distribution, and dependence on film thickness are shown. Also a linear increase in radiation energy with increasing electron energy is shown, and it was observed that the intensity decreased with the time of electron bombardment of the film. (J.F.P.)

26367 BINDING ENERGY OF OXYGEN TO A DISLOCATION IN TANTALUM. Formby, C. L.; Owen, W. S. (Univ. of Liverpool). Phil. Mag., (8), 13: 41-52(Jan. 1966).

The binding energy between an oxygen atom and a dislocation in tantalum was determined experimentally by measuring the critical temperature, T_c, at which the discontinuous yield disappears on heating. By assuming that T_c is the temperature at which the atmosphere is boiled off and estimating the saturation concentration, C_s, of oxygen at a dislocation from the analysis of Cochardt, Schoek, and Wiedersich, using a value for the lattice distortion surrounding an oxygen atom deduced from x-ray measurements, the binding energy V_B is found from $C_s = C_0 \exp(-V_B/kT_c)$, where C_0 is the concentration of oxygen at a large distance from the dislocation. As an example of the use to which a knowledge of the binding energy can be put, the theoretical shear strength of tantalum is estimated to be G/9.8 (G is the shear modulus) by a method which does not require the assumption of a specific law of interatomic forces. (auth)

26368 ELECTRON MICROSCOPY OF FISSION FRAGMENT DAMAGE. Chadderton, L. T.; Morgan, D. V.; Torrens, I. McC.; Van Vliet, D. (Cambridge Univ., Eng.). Phil. Mag. (8), 13: 185-95(Jan. 1966).

The damage produced in a single crystal by excited electrons energized by a fission fragment is explained on the basis of a simple classical model. An average primary electron, or delta particle, possesses a typical energy of some 80 ev, and this is communicated to the lattice, first by electron/electron interactions and then by electron/phonon interactions. A critical parameter is the effective range x_s traversed by a typical secondary electron, and the magnitude of x_s is a function of the nature of the lattice vibrations excited. In polar crystals both polar and acoustic modes are important, but in nonpolar crystals only acoustic modes need be accounted for. Optical modes are relatively unimportant. The nature of the fission fragment damage observed by electron microscopy is shown to depend also upon the rate at which the secondary electrons are produced by the primaries, on the activation energies for defect-creating and defect-migrating processes, and on whether the crystal is an element or a compound. (auth)

26369 DEBYE TEMPERATURE CHANGES IN MICROCRYSTALS. Schroeer, D. (Technische Hochschule, Munich). Phys. Lett., 21: 123-5(May 1, 1966).

The variation in the Debye temperature for microcrystals, which manifests itself in changes in the Debye-Waller factor of Mössbauer spectra, is related to lattice constant changes. (auth)

26370 F CENTER IN CALCIUM FLUORIDE. Kamikawa, T.; Kazumata, Y.; Kikuchi, A.; Ozawa, K. (Japan Atomic Energy Research Inst., Tokyo). Phys. Lett., 21: 126-8(May 1, 1966).

Synthetic CaF_2 crystals were irradiated with electrons and optically studied at liquid helium temperature. An absorption band was observed at 375 nm, which is suggested to be the F band. The characteristics of the F center in CaF_2 are discussed. (auth)

26371 MAGNETIC INVESTIGATIONS OF NEW TERNARY RARE-EARTH CHALCOGENIDES. Hulliger, F. (Cyanamid European Research Inst., Geneva); Vogt, O. Phys. Lett., 21: 138-9(May 1, 1966).

In the $CaFe_2O_4$-type sulfides and selenides $EuLn_2X_4$ magnetic ordering to the Eu sublattice was shown to occur for Ln = Lu, Y, and Sc, while the Ln lattice was found to occur only with Ln = Tb. (auth)

26372 EFFECTIVE MAGNETIC FIELDS AT Sm, Gd, AND Dy NUCLEI IN METALLIC Fe FOLLOWING COULOMB EXCITATION IMPLANTATION. Grodzins, L.; Borchers, R.; Hagemann, G. B. (Univ. of Copenhagen). Phys. Lett., 21: 214-17(May 1, 1966).

A technique for the study of internal fields in solids is described which utilizes Coulomb excitation by means of ^{16}O ions to both excite a nuclear state and propel the nucleus into an arbitrary host backing. The perturbed angular distribution of the de-excitation γ's with respect to the back-scattered ^{16}O ions measures the electromagnetic interaction of the nuclear state with the lattice environment. Larmor precession of the $(^{16}O',\gamma)$ distribution was observed from Sm, Gd and Dy implanted in a magnetized iron host. The deduced values of H_{eff} are approximately +1.3, –0.2 and –2.0 mOe, respectively, indicating an antiferromagnetic coupling of the rare earths-Fe moments. (auth)

26373 INTERNAL MAGNETIC FIELDS OF RARE EARTHS IN IRON. Boehm, F.; Hagemann, G. B.; Winther, A. (Unif. of Copenhagen). Phys. Lett., 21: 217-20 (May 1, 1966).

Internal magnetic fields at the sites of rare earth atoms dissolved in an iron host were studied with Coulomb excitation technique. The fields are found to be large and positive for the first half of the 4f shell and negative for the second half. (auth)

26374 THE CONTRIBUTION OF ISOLATED AND GROUP DEFECTS TO THE CHANGE IN CARRIER MOBILITY AND CONCENTRATION IN n-Ge DURING BOMBARDMENT BY FAST NEUTRONS. Starostin, K. L.; Tuturov, Yu. F.; Milovanov, Yu. P. Soviet Phys.-Solid State (Engl. Transl.), 7: 2347-9(Apr. 1966).

Translated from Fiz. Tverd. Tela, 7: 2890-3(Oct. 1965).

The Hall effect and conductivity of n–Ge are measured during bombardment with near fission spectrum neutrons at T = 308 and 100°K. On the basis of formulas previously given, the contributions of isolated and group defects to the change in these quantities are separated. In the case of bombardment at low temperatures the contribution of the latter is shown to be considerably greater than at room temperature. The mobility of electrons in the lattice remains constant at least until the fraction of the volume occupied by the space charge regions reaches 0.45 at T = 308°K and 0.17 at T = 100°K. (auth)

26375 ELECTRICAL CONDUCTIVITY OF INVERSION LAYERS FORMED IN n-SILICON BY BOMBARDMENT WITH BORON IONS. Pavlov, P. V.; Zorin, E. I.; Tetel'baum, D. I.; Granitsyna, E. K. (Lobachevskii State Univ., Gor'ki, USSR). Soviet Phys.-Solid State (Engl. Transl.), 7: 2386-90(Apr. 1966).

Translated from Fiz. Tverd. Tela, 7: 2940-6(Oct. 1965).

The results of conductivity measurements in inversion layers formed in n-silicon by surface bombardment with boron ions having energies of 25 to 150 kev are presented. The effects of irradiation dosage and of the temperature and duration of annealing are investigated. The data thus obtained are discussed from the point of view of the most simple processes occurring during annealing. It is also shown that it is possible to form inversion layers by bombardment without subsequent annealing. (auth)

26376 INVESTIGATION OF THE HALL EFFECT IN GADOLINIUM AND TERBIUM. Babushkina, N. A. (Kurchatov Atomic Energy Inst., Moscow). Soviet Phys.-Solid State (Engl. Transl.), 7: 2450-4(Apr. 1966).

Translated from Fiz. Tverd. Tela, 7: 3026-32(Oct. 1965).

The Hall effect was measured in the rare-earth metals gadolinium and terbium in the temperature range 20–500°K. The temperature dependence of the ferromagnetic Hall coefficient R_S was investigated. It was found that $R_S \sim T^2$ over a wide range of temperatures. This dependence was in agreement with the theoretical predictions. (auth)

26377 CERTAIN POLARIZATION EFFECTS IN SCATTERING OF NEUTRONS IN SOLIDS. Ginzburg, S. L.; Maleev, S. V. Ioffe Physico-Technical Inst., Leningrad).

Soviet Phys.-Solid State (Engl. Transl.), 7: 2477-81(Apr. 1966).
Translated from Fiz. Tverd. Tela, 7, 3063-9(Oct. 1965).

The problem of polarization effects associated with neutron scattering by impurities and by conduction electrons is investigated. It is shown that investigation of the dependence of the polarization of neutrons scattered in a specified direction on the scattered neutron energy makes it possible to extract from the experimental data the contribution due to scattering by impurities in the case when the impurity is an atom whose nucleus has spin or is a paramagnetic atom. In the case of scattering by conduction electrons approximate equations are derived for the cross section and polarization of the scattered neutrons, these equations being valid for small angles of scattering. It is shown that the polarization of the scattered neutrons is strongly dependent on the mutual orientation of the incident beam, polarization vector of the incident neutrons, and the scattering plane. (auth)

26378 APPEARANCE OF AN EMF ON ANNEALING OF NaCl:Ag SINGLE CRYSTALS IRRADIATED WITH BETA PARTICLES. Avdonin, V. P.; Vasil'ev, I. A.; Mikhal'chenko, G. A.; Plachenov, B. T.; Shibaev, V. A. (Lensovet Technological Inst., Leningrad). Soviet Phys.-Solid State (Engl.Transl.), 7: 2514-15(Apr. 1966).
Translated from Fiz. Tverd. Tela, 7: 3110-11(Oct. 1965).

If a single crystal of an alkali-halide crystal phosphor, on whose opposite faces electrodes are deposited, is irradiated with beta particles and heated at a constant rate, a potential difference appears between the electrodes whose variation corresponds to the variation of the thermoluminescence. The results of an investigation of this effect in crystals of NaCl + 0.005% AgCl are presented. (auth)

26379 MOESSBAUER SPECTRA OF SOME IRON COMPOUNDS. Gibb, T. C.; Greenwood, N. N. (Univ. of Newcastle-upon-Tyne, Eng.). pp 143-55 of STI-DOC-10/50.

Some Moessbauer studies of the direction of electron transfer in ferromagnetic iron borides, the oxidation states of iron in amosite and crocidolite, and bonding in $FeCl_4^{2-}$ are summarized. (D.C.W.)

26380 CHEMICAL ASPECTS OF ISOMER SHIFTS AND QUADRUPOLE SPLITTINGS IN TIN COMPOUNDS. Cordey-Hayes, M. (Univ. of Birmingham, Eng.). pp 156-63 of STI-DOC-10/50.

The essential features of the isomer shifts and quadrupole splittings of the 23.8-kev level of ^{119}Sn in tin compounds are outlined. A summary of data for inorganic tin compounds is presented. The results are used as a framework for measurements on organic tin compounds. (D.C.W.)

26381 MOESSBAUER SPECTRA OF SOME ORGANOTIN COMPOUNDS. Gibb, T. C.; Greenwood, N. N. (Univ. of Newcastle-upon-Tyne, Eng.). pp 163-8 of STI-DOC-10/50.

The results of a study of a series of triphenylstannyl compounds are presented. Despite the absence of a regular tetrahedral environment for the tin atom in most of the compounds, no quadrupole effect was detected. This result, and the chemical shifts observed, are discussed in terms of structure and bonding in these compounds. (D.C.W.)

26382 USE OF MOESSBAUER SPECTROSCOPY TO STUDY "BARENES" DERIVED FROM STANNO-ORGANIC COMPOUNDS. Aleksandrov, A. Yu.; Bregadze, V. I.; Gol'danskii, V. I.; Zakharkin, L. I.; Okhlobystin, O. Yu.; Khrapov, V. V. (Inst. of Chemical Physics, Academy of Sciences, USSR. Inst. of Elementary Organic Compounds, Moscow). pp 168-73 of STI-DOC-10/50. (In Russian).

The results of some measurements of the Mössbauer spectra of some stanno-organic compounds with the carborane group are summarized. (D.C.W.)

26383 ISOMER SHIFTS IN RARE EARTHS. Henning, W.; Huefner, S.; Kienle, P.; Quitmann, D.; Steichele, E. (Technische Hochschule, Darmstadt, Ger.). pp 173-8 of STI-DOC-10/50.

The validity of the accepted concepts of the isomer shift is discussed, together with the calibration of electron densities and the investigation of bonding in rare-earth compounds on the basis of measurements of isomer shifts. (D.C.W.)

26384 THE MOESSBAUER EFFECT IN THE NOBLE GASES. A REVIEW. Hillman, P. (Weizmann Institute of Science, Rehovoth, Israel). pp 205-12 of STI-DOC-10/50.

Some Mössbauer studies of chemical and physical binding, in which ^{83}Kr, ^{129}Xe, and ^{133}Xe, were used are briefly reviewed. Studies of frozen gases, clathrate compounds, and rare-gas compounds are included. (D.C.W.)

26385 SOME RECENT CONTRIBUTIONS TO THE STUDY OF THE MAGNETISM OF METALS, ALLOYS, AND INTERMETALLIC COMPOUNDS. Werthein, G. K. (Bell Telephone Labs., Murray Hill, N. J.). pp 237-49 of STI-DOC-10/50.

The contributions of the Mössbauer effect to the understanding of the magnetism of alloys, intermetallic compounds, and metals are outlined in a discussion of some recent research. (D.C.W.)

26386 THE RESISTANCE CHANGES OF InSb IN HIGH MAGNETIC FIELDS ABOVE ROOM TEMPERATURE. Sun, Sua-for; Wagini, Herbert (Siemens-Schuckert-Werke AG, Erlangen, Ger.). Z. Angew. Phys., 20: 318-22(Apr. 1966). (In German).

The magnetoresistance of intrinsic InSb was measured in pulsating magnetic fields up to 120 kG at high temperatures. Based upon the data of the change of resistance in a magnetic field, the concentration and the mobility of the fast holes were calculated at different temperatures, taking into account the scattering mechanism of the electrons. The relative concentration of the fast holes compared to the concentration of slow holes in intrinsic InSb increased from approximately 1% at room temperature to 5% at 700°K, while the mobility decreased from 2×10^4 to 5×10^3 $cm^2/vsec$ in the same temperature range. (auth)

26387 ON THE AGING OF ELECTROLUMINESCENT ZnS: Cu PHOSPHORS. Hahn, Dietrich; Mimkes, Juergen (Physikalisch-Technische Bundesanstalt, Berlin). Z. Angew. Phys., 20: 458-61(Apr. 1966). (In German).

The voltage dependence of aged electroluminescent phosphors is given by a formula for the brightness being a function of applied voltage, aging voltage, and aging time. The formula can be interpreted by impact ionization. According to this aging of electroluminescence is due to lattice imperfections built up by accelerated electrons with energies higher than $E_s = 2$ ev. (auth)

26388 THERMOLUMINESCENCE OF NaCl/Ag. Rothermel, Horst M.; Scharmann, Arthur (Univ., Giessen, Ger.). Z. Phys., 192: 1-12(1966). (In German).

The thermoluminescent glow-curves of single crystals of NaCl(Ag) were measured after x irradiation of the crystals. Spectral distributions were also obtained. (G.O.Y.)

26389 OSCILLATOR STRENGTH OF THE 4.23-ev ABSORPTION BAND IN NaI(Tl) CRYSTALS. Leutz, H.; Schulz, G. (Univ., Heidelberg). Z. Phys., 192: 299-304 (1966).

NaI(Tl) crystals were grown and Tl concentrations, which varied from 1.07×10^{18} cm^{-3} to 8.13×10^{18} cm^{-3}, were determined by radiochemical methods. From optical absorption measurements an oscillation strength of 0.120 ± 0.006 was determined for the 4.23-ev absorption band of NaI(Tl). (tr-auth)

26390 ISOMERIC SHIFTS IN ^{119}Sn NUCLEI IN ELECTRONIC COMPOUNDS OF A COPPER–TIN SYSTEM. Chekin, V. V.; Naumov, V. G. (Inst. of Physics and Tech. of Low Temperatures, Academy of Sciences, Ukrainian SSR). Zh. Eksp. Teor. Fiz., 50: 534-6(Mar. 1966). (In Russian).

Isomeric shifts on ^{119}Sn nuclei in electronic compounds of a copper–tin system are measured. A nonlinear dependence of the magnitude of the isomeric shift on tin concentration is observed which evidently can be ascribed to a change in the nature of the interatomic binding forces. (auth)

26391 MAGNETIC ANISOTROPY OF TERBIUM. Belov, K. P.; Ergin, Yu. V. Zh. Eksp. Teor. Fiz., 50: 560-4(Mar. 1966). (In Russian).

The temperature dependence of the magnetic anisotropy energy near the temperature of destruction of magnetic ordering (Curie point) is estimated on basis of the magnetization isotherms for terbium single crystals measured along the axes of easy and difficult magnetization. The effective anisotropy field leads to an apparent lowering of the Curie temperature along the axes of difficult magnetization by approximately 30°. (auth)

26392 INTERACTION OF PLASMA AND SPIN WAVES IN FERROMAGNETIC SEMICONDUCTORS AND METALS. Bar'yakhtar, V. G.; Savchenko, M. A.; Stepanov, K. N. (Inst. of Physics and Tech., Kiev). Zh. Eksp. Teor. Fiz., 50: 576-88(Mar. 1966). (In Russian).

Bound plasma, electromagnetic and spin waves in ferromagnetic semiconductors and metals with magnetic anisotropy of the "easy axis" and "easy plane" type are considered. The region of wave vectors k is investigated in which space dispersion of the magnetic permeability tensor may be significant but space dispersion of the dielectric permeability is weak (the wave length is much greater than the Larmor electron radius and the phase velocity of the waves is much greater than the thermal of Fermi velocity of the electrons). The refractive indices of the waves are determined and the transparency regions are determined. It is shown that bound waves may possess anomalous dispersion (uncoupled spin waves and electromagnetic waves in the plasma in the absence of space dispersion of the ϵ tensor possess normal dispersion). The spectra of bound cyclotron and spin waves moving perpendicular to the magnetic field are also determined in the case when the wave length is of the order of the Larmor electron radius. (auth)

REACTOR TECHNOLOGY

General

Refer also to abstract 25252.

26393 (AERE-R-4584) LIQUID-HYDROGEN EXPLOSIONS IN CONTAINMENT VESSELS. Pearce, D. G.; Ward, D. L.; Hayes, P. (Atomic Energy Research Establishment, Harwell (England)). Feb. 1966. 70p. Dep. BIS $2.50. HMSO 12s.

A series of explosions of liquid hydrogen and solid air were performed in closed vessels. The proportions of hydrogen and air, the quantities in relation to the containment volume, and the containment volumes and L/D ratio themselves, were all varied, and the resulting pressures, variations, and peak pressures were measured against time. The results were analyzed here and compared with theoretical analyses. The dynamic response of typical containment vessels suitable for use in nuclear reactors was considered and compared with the time characteristics of the explosion forces. It was clear that relevant theories were difficult to locate despite intensive inquiries. Considerable scatter was observed in the results and apparent anomalies observed when evaluating explosion efficiencies. Nevertheless despite these circumstances the series of experiments was useful and contributed appreciably to a better understanding of the problems involved. (P.C.H.)

26394 (ANL-7193) REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, MARCH 1966. (Argonne National Lab., Ill.). Apr. 22, 1966. Contract W-31-109-eng-38. 109p. Dep. mn. CFSTI $4.00 cy, $0.75 mn.

Various aspects of research directed toward the further development of liquid-metal-cooled reactors are presented for the following six areas: EBR-II general fast reactor physics, general fast reactor fuel development, general fast reactor fuel reprocessing development, sodium technology, and general fast reactor component development. Research on reactor technology in general is directed toward the following: experimental reactor and nuclear physics, theoretical reactor physics, instrumentation, high-temperature materials studies, other reactor fuels and materials development, engineering development, chemical separations, and the Plutonium Recycle Program. Further research is reported on the Argonne Advanced Research Reactor, desalination, and nuclear safety experiments. (M.O.W.)

26395 (BNL-10138) RESEARCH FOR REACTOR SAFETY IN THE UNITED STATES. Kouts, Herbert J. (Brookhaven National Lab., Upton, N. Y.). Apr. 1966. Contract AT(30-2)-Gen-16. 17p. (CONF-660312-4). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From Nederlands Atoomforum, Utrecht.

The assessment of the safety of nuclear reactors in the United States is a combination of many judgements. One must form opinions on the inherent features of the nuclear plant, the proposed method of operation, the reliability of components, the conceivable modes of failure, the sequence of events that might follow various kinds of hypothetical failure, and the reliability and efficiency of devices that are meant to minimize the effects of any failure. In many cases, the available scientific information on the phenomena is inadequate for realistic conclusions, and it has been necessary to make assumptions. These are intentionally conservative, because of a desire to be too safe rather than not safe enough if the proper choice is not clear. The research that is being done to improve the safety and its analysis is done partly by manufacturers, and partly through the reactor development program of the Atomic Energy Commission. The number of kinds of problems being studied is very large. The program is described, with emphasis on its major aspects. Personal views on its expectations will be given. (auth)

26396 (IDO-17140) NUCLEAR TECHNOLOGY BRANCHES QUARTERLY REPORT, APRIL 1-JUNE 30, 1965. (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). Mar. 1966. Contract AT(10-1)-205. 126p. Dep. mn. CFSTI $4.00 cy, $0.75 mn.

Power, thermal flux, and fast flux distributions were measured in the Advanced Test Reactor Critical Assembly (ATRC) with shims in a configuration to give equal power generation in each of the five lobes. The void coefficient of reactivity in the fuel annulus is positive in coolant channel 20, zero in channel 19, and strongly negative in the center channels. The reactivity worth of outer shims in the ATRC was found to vary significantly with changes in flux trap composition. The shutdown worth of ATR Hf safety rods is about $10, which is at least 30% more than the worth of the ATRC Cd safety rods. A metallographic comparison between three identical UO_2-Al fuel plates, one as-fabricated, one heated out-of-pile for 45 days at 205°C, and a third one irradiated for 45 days at 205°C, showed that the fuel material in the plate heated out-of-pile did not react while the fuel in the irradiated plate was fully reacted. By utilizing the electron microscope, evidence was found which indicated that UAl_4 retains fission gas within the lattice to a greater extent than does UAl_3, for a given burnup and irradiation temperature. A special thermocouple assembly to allow fuel plate temperature measurements subsequent to operation in ETR is described. Preliminary results are reported on the decay of ^{148}Eu. Over one-hundred transitions were identified as arising from this decay. On the basis of coincidence studies and energy and intensity determinations, approximately 50% of these transitions were fit into a tentative decay scheme. The operating characteristics of the electronic system used in the Ge(Li) spectrometers were investigated. Following a careful analysis of these characteristics, a procedure was developed which will permit the measuring of gamma-ray energies with a precision, in most instances, of about 0.2 kev. A description of the program for computation of potential radiological hazards is described. A number of computer programs were completed during the quarter. They include a program for cataloging all computer codes which are on file at the NRTS Computing Center, a number of personnel programs for use with the personnel master tape, an internal sort subroutine, and a program for analyzing data collected at the ETRC facility. This last program was written in a general fashion to facilitate its application to the analysis of general data. (auth)

26397 (RISO-M-348) REDEGOERELSE FOR EN RAEKKE GASKOELEDE, D_2O-MODEREREDE REAKTOR-PROJEKTER. (Report on a Series of Gas-Cooled D_2O-Moderated Reactor Projects). Lantow, E.; Marstrand, J.; Muller, M.; Petersen, E. Storm (Danish Atomic Energy Commission, Risoe, Research Establishment). Dec. 1965. 263p. Dep. mn.

The present status of D_2O-moderated gas-cooled reactors is reported. The projects described are Bohunic in Czechoslovakia, ECNG in the United States, EL-4 in France, Lucens in Switzerland, and the AKB in Germany. The subsystems such as the primary and secondary circuits, fuel elements, and refueling machines are discussed. The safety aspects including reactivity accidents and reactor stability, failure of reactor components, loss of gas circulation, chemical and nuclear reactions, and fission product release and containment are discussed. The operating cost of the various reactor installations and the economy of the reactors are considered. The future reactor cost is discussed. (J.S.R.)

26398 INSULATION OF ORGANIC-COOLED REACTOR PRESSURE TUBES WITH THE USE OF THE FLOWING COOLANT AS AN INSULANT. Rogers, James T. (Canadian General Electric Co., Ltd., Peterborough, Ont.). Chem. Eng. Progr., 61: Symp. Ser. No. 60, 114-26(1965).

One method to insulate the fuel channels in an organic-cooled, heavy-water moderated pressure tube reactor is to utilize a small fraction of the organic coolant itself flowing in parallel to the fuel channel flow in a narrow annulus between the pressure tube and a liner which forms the outer boundary of the fuel channel. Preliminary work produced an annulus configuration which provides good insulation effectiveness and low coolant residence time in the core and which gave promise of meeting other design requirements of neutron economy and mechanical reliability and simplicity. The chosen annulus configuration has an inner wall of widely spaced circumferential rings with very narrow gaps between the rings and the outer wall of the annulus. The rings restrict the annulus flow to the laminar regime and the resulting annulus Nusselt numbers are lower than 2.0 at representative reactor core pressure drops. An analytical method is developed which gives good agreement with the experimental results. The work shows the effect of ring pitch on annulus conductance and shows that the narrow ring clearance gaps generally do not close up completely under operating conditions even when interference between rings and pressure tube is predicted. Annulus flow instability can occur under certain conditions. Finally, remaining problems to be solved are listed. (auth)

Auxiliaries and Components

Refer also to abstract 25438.

26399 (ITEF-402) OPTIMAL'NOE RASPOLOZHENIE REGULYATOROV. (The Optimum Distribution of Control Elements). Myrtsymova, L. A.; Rudik, A. P. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi i Eksperimental'noi Fiziki). 1965. 12p. Dep. mn.

The Pontryagin's maximum principle is used to solve the optimum distribution of control elements problem. (auth)

26400 (NYO-3622-2) APPLICATIONS OF ULTRASONIC ENERGY: ULTRASONIC INSTRUMENTATION FOR NUCLEAR APPLICATIONS. Bimonthly Progress Report No. 27, February 1-March 31, 1966. (Aeroprojects, Inc., West Chester, Pa.). Apr. 1966. Contract AT(30-1)-3622. 7p. Dep. mn. CFSTI $0.50 cy, $0.50 mn.

Installation of the twice-modified incipient boiling detector is now in progress in the facility of the Molten Metal Reactor Group at Oak Ridge National Laboratory. Aeroprojects personnel will be advised of the completed installation in order to carry out the necessary proof tests. Construction of the ultrasonic flowmeter test loop has begun. Initial measurements with the system are projected for the first week of May. (auth)

26401 (ORNL-NSIC-15) THE INTEGRITY OF REACTOR PRESSURE VESSELS. Miller, E. C. (Oak Ridge National Lab., Tenn.). May 1966. Contract W-7405-eng-26. 61p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

Some of the significant information relevant to the long-time integrity of nuclear reactor vessels is reviewed and presented as a brief critical survey. Nuclear-related accidents were studied to determine if penetrations or ruptures of pressure boundaries — either as cause or result — were involved. The records of service performance (and failures) of non-nuclear equipment — boilers, pressure vessels, and piping — were examined for information significant to reactor vessel performance. The extensive literature on factors holding failure-contribution potential was reviewed to determine their relevance to probable reactor vessel performance; these include: structural adequacy as determined by design, materials and fabrication; service deterioration resulting from chemical, mechanical, thermal, metallurgical, or radiation causes; growth of flaws by thermal or mechanical fatigue cycling; high temperature creep; rupture by brittle fracture of ductile tear and, of course, human errors. Measures that can contribute to reliability of vessels are discussed. (110 references). (auth)

26402 (UNC-5149) PERFORMANCE EVALUATION OF HEAT EXCHANGERS FOR SODIUM-COOLED REACTORS. Quarterly Technical Progress Report, January 1-March 31, 1966. Dischinger, R. H. (United Nuclear Corp., Elmsford, N. Y.). Apr. 20, 1966. Contract AT(11-1)-1452. 18p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

The evaluation is based on test results using model heat exchangers at 30 Mw(t) in the Sodium Components Test Installation. Preparations were made for evaluation of an intermediate heat exchanger and boiler. Data and information concerning the design and testing of a 25.2 Mw(t) boiler were reviewed during the report period. (J.R.D.)

26403 (WAPD-TM-414) M0341: A DIGITAL COMPUTER PROGRAM FOR CALCULATION OF STEAM GENERATOR EQUIVALENT GEOMETRIES. McGowan, E. J. (Bettis Atomic Power Lab., Pittsburgh, Pa.). Mar. 1966. Contract AT(11-1)-Gen-14. 25p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

The flow path on the stream side of a recirculating steam generator is often made up of a large number of nonuniform sections (varying flow area, hydraulic characteristics, and heat input). The M0341 digital program discussed herein may be used to convert steam generator representations from many nonuniform sections into an equivalent geometry for a three-part system. (auth)

26404 (WAPD-TM-415) RIB-2—A PROGRAM TO DETERMINE RECIRCULATION AND STABILITY IN STEAM GENERATORS. Funk, J. E.; Larson, J. V. (Bettis Atomic Power Lab., Pittsburgh, Pa.). Apr. 1966. Contracts NObs-78844; AT-11-1-GEN-14. 33p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

RIB-2 is a digital computer program which calculates the steady-state recirculation ratio and a measure of stability for a steam generator when the geometry and operating conditions are specified. The basis for RIB-2 is the SMAL program which was written to determine stability and flow-pressure drop relationships for a heated channel and the associated inlet and outlet piping. Before RIB-2 can be used, it is necessary to determine a set of equivalent parameters which relate the steam generator to the inlet piping, the channel, and the outlet piping. A method of determining these equivalent parameters, along with a sample problem, is included. (auth)

26405 AN APPROXIMATE PROCEDURE FOR CALCULATING THERMAL STRESSES IN CYLINDRICAL NUCLEAR VESSELS. Oliveri, Elio (Univ., Palermo, Italy). Ing. Nucl., 6: 284-90(Nov.-Dec. 1965).

The theory of thermal stresses in cylindrical shells is outlined, and a method for calculating the steady-state thermal stresses in cylindrical vessels is described. (D.C.W.)

26406 THE PROCESSING OF REACTOR CIRCUIT WATER IN AN EVAPORATOR. Nazarov, A.; Golubev, E.; Metalnikov, C. (State Committee on the Utilization of Atomic Energy, Moscow). Vienna, International Atomic Energy Agency, 1965, Preprint No. SM-71/33, 12p. (In Russian). (CONF-651202-33). ORAU.

From Symposium on Practices in the Treatment of Low and Intermediate Level Radioactive Waste, Vienna.

A description and results of studies on the operation of equipment for vapor purification of reactor coolant water in which the vapor is washed in a layer of condensate according to a method developed by the Moscow branch of the Central Steam Turbine Research and Development Institute are given; a description is also given of a multistage plant with automation used for processing the scavenging water of the reactor installation. Studies were made on an evaporator of the vertical type with an external heating chamber. Arranged in the evaporator scrubber were two perforated scavenging plates on which the condensate collected to an amount of 5% of the evaporator capacity for washing the vapor. In the upper part of the scrubber above the plates a jalousie-type separator was mounted to give extra drying of the secondary vapor. For operational and visual control of the apparatus and control of the automatic feed circuit, lamps were fitted in the scrubber. Studies of the operation of this apparatus during processing of the reactor circuit water showed that the automatic feed control guarantees reliable operation of the evaporator and

high-quality distillate. With outlet waters of activity of up to 10^{-2} C/l evaporation gave concentrate with an activity of 1–3 C/l and the activity of the distillate was consistently below about 10^{-7} C/l. The multistage plant consists of four vertical units. The first unit is also the expander, i.e., the scavenging water from the reactor or the steam generators is fed to it at a water pressure of 30–100 ata at saturation temperature, the pressure in the evaporator unit being maintained at 6 ata. The units are fed with water and vapor in succession. Scavenging of the evaporator to an auxiliary evaporator takes place from the last unit. In each vapor purification unit two washing plates are arranged. The distillate collects on the first plate of each unit. The second plate is then fed. The amount of washing distillate is 5% of the capacity of the unit. The evaporating plant is entirely automated and electronically controlled. (auth)

26407 IMPROVEMENTS IN OR RELATING TO PRESSURE VESSELS. Crowther, Herbert (to Atomic Power Constructions Ltd.). British Patent 1,022,447. Mar. 16, 1966. Filed Oct. 5, 1961.

Access means are described for pressure vessels, particularly spherical pressure vessels, for nuclear reactors. A sleeve is secured in an aperture in the vessel wall with the longitudinal axis of the sleeve directed towards the interior of the vessel. With one end of the sleeve located within the vessel a tube is located partly within the sleeve with the axis of the tube also directed towards the interior of the vessel. The tube is secured to the sleeve only at or adjacent to that end of the sleeve inside the vessel. This arrangement imparts a greater degree of freedom of flex to the tube (standpipe) or alternatively a reduction in overall length as compared to usual access means. (B.L.M.)

26408 APPARATUS FOR MEASURING RATES OF CHANGE OF TEMPERATURE. Moores, Harry; Derrick, John Michael (to English Electric Co., Ltd.). British Patent 1,023,585. Mar. 23, 1966. Filed Oct. 26, 1961.

An apparatus for measuring rates of change of temperature at the surface of a nuclear fuel element comprises a pair of thermocouples having substantially the same time constant and attached to the fuel element diametrically opposite each other. One of the thermocouples is sheathed in an outer member of a ceramic material so as to increase its effective time constant over that of the other thermocouple. The two thermocouples are connected differentially together and to electrical indicating means that is responsive to output signals from the thermocouples, so that the indicating means can receive the signals with a time delay between them to give an indication of the rates of change. (B.L.M.)

26409 IMPROVEMENTS IN AND RELATING TO NUCLEAR REACTORS. (to Societe Anglo-Belge Vulcain). British Patent 1,024,370. Mar. 30, 1966. Priority date Aug. 11, 1962, Belgium.

A method is described for the partial or total extraction of one or several substances, such as impurities, corrosion products, or soluble poisons, in solution and/or suspension in a liquid circulating in a reactor. The fluid may be of any nature and its purpose in the reactor may be that of coolant, and/or moderator, and/or reflector, and/or a regulating fluid, and/or an intermediary fluid for heat transfer. A fraction of the fluid circulating in the primary circuit including the core of the reactor is branched off into a derived circuit out of the core and is subjected to distillation at a total pressure substantially equal to that available in the primary circuit. The vapor formed in the distillation is returned to the primary circuit, and the residual liquid concentrate is extracted from the derived circuit. The heating necessary for the distillation may be supplied by several different ways, e.g., electrical resistances, tubes through which passes a heating fluid, or materials heated by gamma radiation from the reactor. (B.L.M.)

26410 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTOR OPERATION. Robertson, Robert Ian; Horsley, Ronald Michael (to United Kingdom Atomic Energy Authority). British Patent 1,025,114. Apr. 6, 1966. Filed Aug. 9, 1962.

A method is described for detecting potential fast bursts in fuel element sheaths in gas cooled reactors. The method consists of selectively varying the power and coolant mass flow parameters of the reactor while maintaining substantially constant the pressure in the closed circuit. If a sheath has an undetected leak, increasing the temperature difference between the fissile member and the sheath effects a reduction in the interspace volume between the fissile member and the sheath to establish a pressure gradient across the leak with pressure decreasing towards the sheath exterior with consequent emission of detectable fission products into the gas or vapor stream. (B.L.M.)

26411 HEAT TRANSFER SYSTEM FOR A NUCLEAR REACTOR. Lindberg, John Emery Jr. British Patent 1,025,551. Apr. 14, 1966. Filed Feb. 11, 1963.

A heat transfer system for a nuclear reactor employs a metal hydride as the heat transfer medium. The metal hydride is contained in the reactor and is a hydride that is dissociable endothermically into the metal and hydrogen. The metal and hydrogen are conducted to the heat exchange facilities that include means for the recombination of the metal and hydrogen exothermically and for returning the recombined hydride to the reactor. The heat is conducted from the heat exchanger to a point of utilization. The preferred hydrides for this use are LiH and ZrH_4, because their neutron cross sections, as well as that of H_2, make them useful as moderators as well as heat transfer media. These hydrides also can serve as radiation shields. (B.L.M.)

26412 DEVICE FOR LIMITING FLUID FLOW IN A CONDUIT. Lemaitre, Rene; Roche, Roland (to Commissariat a l'Energie Atomique). Canadian Patent 723,259. Dec. 7, 1965. Priority date Apr. 13, 1961, France.

In the event of rupture of the pressure tube in a liquid-moderated reactor, it is desirable to limit the flow of the gas coolant yet allow sufficient cooling during shutdown. The gas enters through a nozzle of dimensions such that the velocity is less than that of sound. In the event of a rupture or large leak in the pressure tube, the pressure drop beyond the nozzle causes sonic flow which actuates a needle valve. The gas flow to the pressure tube is reduced to prevent fuel melting. A similar nozzle is included at the outlet end of the pressure tube. (F.S.A.)

26413 CONTAINER FOR SAMPLES TO BE IRRADIATED. (to Commissariat a l'Energie Atomique). French Patent 1,366,219. June 1, 1964. Filed May 31, 1963.

A container was designed for introduction into a nuclear reactor channel instead of a fuel element or a group of fuel elements. The container consists of a chamber to accommodate the sample and means for regulating the temperature prevailing within the chamber. The temperature can be maintained at a predetermined value. (IIB)

26414 CLOSING DEVICE FOR THE VESSEL BOTTOM APERTURES OF NUCLEAR REACTORS. Gerard, Victor Jean; Martin, Jean Antoine (to Groupement-Atomique Alsacienne Atlantique GAAA). German Patent 1,210,495. Feb. 10, 1966. Priority date Aug. 7, 1961, France.

A closure plug was designed for tank-bottom apertures of nuclear reactors. A means for inserting, locking, unlocking, and removing the plug was also developed. The closure plug is adapted to slide into and plug one of the apertures. Locking means within the plug consists of a plurality of bolts controlled by a resilient element. Means are provided in the wall of the aperture for receiving the bolts and for positioning the plug in the aperture. Extracting means are provided for gripping and unlocking the plug for removal from the aperture. A carrier was adapted to receive the inserting and extracting means, to support the plug for its positioning and removal, and to provide for symmetrical operation of the locking means. (Gmelin Inst.)

26415 LINING FOR THE HOUSING OF A NUCLEAR REACTOR VESSEL. Ganowski, Franz-Josef (to Keller and Knappich GmbH). German Patent 1,210,496. Feb. 10, 1966. Filed Oct. 30, 1964.

A lining of corrosion-resistant steel low in carbon is attached to the inner surface of the housing of high-strength

steel by electrical resistance welding. The lining consists of single- or multilayered sheet bars. (Gmelin Inst.)

26416 ROTARY TEST FACILITY FOR NUCLEAR REACTORS. Gumuchian, Andre (to EURATOM). German Patent 1,210,959. Feb. 17, 1966. Priority date Jan. 18, 1962, France.

The irradiation facility comprises a plurality of suitable recesses in the reflector extending parallel to the axis of the core, specimen containers inserted into the recesses, and means for rotating the containers, which are located below the core. The containers are in the shape of a figure of revolution with a vertical reflection plane through the center, on both sides of which are two containers filled with a moderator or a neutron absorbing medium. The common cross section of the two containers adjacent to the reflection plane containing the neutron absorbing medium is of the type of a double-concave diverging lens. The separate cross sections of the two outer containers with the moderator and the irradiation hole are of the type of a double-convex converging lens. (Gmelin Inst.)

26417 CONTROL OR ABSORBER ROD DRIVE. Acher, Heinz (to Licentia Patent-Verwaltungs-GmbH). German Patent 1,210,960. Feb. 17, 1966. Filed Sept. 22, 1961.

The control rod drive comprises a mechanical drive system combined with a fluid drive system, the fluid of which is the same as that used as a coolant. The two drive systems are combined in such a manner that one drive is disposed concentrically inside the other. The combined systems are arranged in the region of the bottom of the pressure vessel of the reactor. (Gmelin Inst.)

26418 DEVICE FOR COUPLING A DISPLACEMENT SHAFT TO A CONTROL ROD OF A NUCLEAR REACTOR. Rothfuss, Helmut (to Interatom, Internationale Atomreaktorbau GmbH). German Patent 1,211,344. Feb. 24, 1966. Filed July 22, 1963.

The coupling mechanism comprises a plurality of latching jaws mounted at the upper end of the driving shaft, which is axially movable within a guide tube and engages the lower end of the control rod. The control rod is provided with a head, a reduced neck, and a shoulder between the head and the neck. The guide tube is provided with a conically enlarged portion positioned opposite the lower end of the fully inserted control rod. In this position the latching jaws move automatically outward enough toward the walls of the guide tube to permit the control rod head to clear the jaw ends. (Gmelin Inst.)

26419 SLIP CAM ARRANGEMENT. Coughren, Kenneth D. (to U. S. Atomic Energy Commission). U. S. Patent 3,238,797. Mar. 8, 1966.

An assembly of two cams with provision for lost motion between them is described. One cam controls the flow of coolant liquid to a reactor and alternately the flow of purging liquid thereto and provides for a condition in which both coolant and purging liquid are cut off from the reactor. The other cam operates an indicator to show, at the time when both liquids are cut off, which liquid flowed to the reactor directly previously to this time. (AEC)

Criticality Studies

Refer also to abstracts 26064 and 26333.

26420 (ANL–7049) SAFETY ANALYSIS OF THE OPERATION OF ZPR-3 WITH FUEL LOADINGS UP TO 430 kg OF PLUTONIUM. Long, J. K.; Kelman, L. R.; McVean, R. L.; Novick, M.; Shuck, A. B.; Thalgott, F. W. (Argonne National Lab., Ill.). Dec. 1965. Contract W-31-109-eng-38. 22p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Addendum to ANL–6504.

The ZPR-3 is now operating with up to 230 kg of plutonium. Experiments are now anticipated, and fuel is on order, to increase the inventory by about 200 kg of plutonium; that is, to about 430 kg. The hazards of ZPR-3 operation are evaluated insofar as they are affected by this increase inventory. (M.O.W.)

26421 (ANL–7133) CALCULATIONS OF ZPR-3 FAST ASSEMBLIES USING A 26-GROUP ARGONNE CROSS-SECTION SET. Meneghetti, D.; White, J. R. (Argonne National Lab., Ill.). Jan. 1966. Contract W-31-109-eng-38. 16p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Calculations of a series of ZPR-3 fast critical assemblies using an Argonne 26-group cross-section set are described. Critical masses, detector-response ratios, and prompt neutron lifetimes are compared with reported experimental values. Comparison of intragroup cross section averaging by P1 and by consistent B1 are presented. Importances of reflectors in determination of prompt neutron lifetimes are also calculated. (auth)

26422 (BNL–10058) THE SENSITIVITY OF REACTOR CHARACTERISTICS TO CROSS SECTION UNCERTAINTIES BELOW 100 ev. Hellens, R. L. (Brookhaven National Lab., Upton, N. Y.). Mar. 1966. Contract AT(30-2)-Gen-16. 44p. (CONF-660303–1). Dep. mn. CFSTI $2.00 cy, $0.50 mn.

From American Physical Society, Conference of Neutron Cross Section Technology, Washington, D. C.

The development of accurate computational methods for thermal reactor lattices has reached the point at which neutron cross section uncertainties are a major limitation to the confidence with which theory can be applied to practical situations. This sensitivity to nuclear data is readily seen in the analysis of extremely simple lattice experiments, although it is still present, of course, in calculations for power reactors of greater geometrical complexity where errors in describing spatial effects may effectively hide basic discrepancies. The basic lattice data and computational methods are briefly reviewed and the connection between uncertainties in cross sections and in predicted reactor characteristics is traced for some typical reactor lattices. The effect during reactor life of changes in the cross sections assigned to both fertile and fissile isotopes in the uranium and plutonium chains is described for some light and heavy water moderated reactors. (auth)

26423 (BNWL-SA–614) SENSITIVITY OF REACTOR MULTIPLICATION VALUES TO CROSS SECTION UNCERTAINTIES FOR THERMAL SYSTEMS. Liikala, R. C.; Purcell, W. L.; Worden, J. R. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Mar. 25, 1966. Contract AT(45-1)-1830. 19p. (CONF-660303–14). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From American Physical Society, Conference of Neutron Cross Section Technology, Washington, D. C.

The effect of uncertainties in microscopic cross sections on reactor multiplication values was determined for a variety of thermal reactor systems. Under the assumptions used in the present analysis, the uncertainties in resonance cross sections lead to larger uncertainties in multiplication values than do the uncertainties in thermal cross sections. (auth)

26424 (CEA-R–2977) CODE ORHEX (DEP 053 S). RESOLUTION DES EQUATIONS DE LA DIFFUSION A DEUX GROUPES DANS UNE GEOMETRIE HEXAGONALE. (The ORHEX Code (DEP 053 S). Resolution of Two-Group Scattering Equations in Hexagonal Geometry). Bayard, Jean-Paul; Guillou, Andre; Guillou, Ginette; Lena, Therese (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Feb. 1966. 60p. Dep. mn.

ORHEX is a code which was written for the IBM-7094 computer. It can solve two-group scattering equations (by calculating the neutron fluxes and the proper valve k_{eff}) for a two-dimensional hexagonal geometry. It is assumed that the cross section of the reactor under consideration can be represented by a juxtaposition of regular homogeneous hexagons; this set-up is particularly well adapted to graphite-type reactors. The equations are solved by alternating exterior iterations in the case of the proper value (acceleration using Tchebycheff's polynomial method) and internal iterations in the case of flux calculations (overrelaxation by blocks). (auth)

26425 (DP-1014) CRITICAL AND SAFE MASSES AND DIMENSIONS OF LATTICES OF U AND UO_2 RODS IN WATER. Clark, Hugh K. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). Feb. 1966. Contract AT(07-2)-1. 60p. (CONF-651103-29). Dep. mn. CFSTI $3.00 cy, $0.75 mn.

From IAEA Symposium on Criticality Control of Fissile Materials, Stockholm.

A survey is given of available critical and exponential data data obtained with water-reflected lattices of slightly enriched uranium and uranium oxide rods. Calculations are made for these lattices by an asymptotic multigroup buckling code and by a two-group diffusion theory code employing parameters generated in the first code. Comparison between calculations and experiments is made in terms of a k_{eff}, which is the ratio of the calculated k to that calculated from the experimental dimensions and flux traverses and from the calculated migration areas and extrapolation distances. For some of the data, comparisons are also made between the present method of calculation and a more highly sophisticated method. Reasonable care is taken in the present calculations to take account of all important effects; but since the experiments are used to normalize the calculations, absolute accuracy in the calculations is not necessary. A least squares treatment is given to k_{eff}, the parameter relating calculation and experiment, in order to obtain an average curve of k_{eff} as a function of the ratio of water to uranium. At low enrichments, k_{eff} is also allowed to vary with rod diameter and enrichment. Nearly all values of k_{eff} lie within ±0.01 of the average curves. Critical masses and dimensions are calculated with the buckling and two-group codes to correspond to values of k_{eff} lying on the average curves; and safe masses and dimensions are calculated to correspond to values of k_{eff} lying 0.02 below the average curves. Tables of minimum critical and maximum safe values are presented as a function of enrichment. (auth)

26426 (IFA-FR-47) STOCHASTIC PROCESSES IN NUCLEAR REACTOR THEORY. Bibliography. Rosescu, Teodor (comp.) (Institutul de Fizica Atomica, Academia R. P. R., Bucharest (Romania)). Sept. 1965. 30p. Dep. mn.

Included are 220 references on statistical aspects in nuclear reactor physics. The references are listed under 12 categories dealing with: stochastic processes, random noise and reactor fluctuations, pulsed experiments and reactor instabilities, damping theory, random-walk, multiple scattering, collision probabilities, Markov processes, Monte Carlo methods, branching processes and renewal theory. (M.O.W.)

26427 (AECL-2330, pp 218-32) CRITICAL EXPERIMENTS WITH THE ORGANIC COOLANTS, MONO-ISOPROPYLDIPHENYL AND GAS OIL. Aleksenko, Yu. N.; Buinitskaya, V. I.; Zaslavskii, V. V.; Zvonov, N. V.; Koslov, V. N.; Meshcheryakov, M. N.; Rogorzhkin, I. V.; Stolpnik, V. P.; Strogonov, V. A.; Yaroslavtsev, B. E. Translated from [pp 182-93] of Issledovaniya po Primeneniyu Organicheskikh Teplonositelei-Zamedlitelei v Energeticheskikh Reaktorakh, Atomizdat, Moscow, 1964.

Critical experiments were performed using fuel elements of type EK-10 (these are standard fuel elements used in reactors of type VVR-S) and the organic moderators monoisopropylbiphenyl (which is a product of the alkylation of diphenyl) and gas-oil (a straight distillation fraction of natural oil representing a mixture of aromatic naphthene and paraffin hydrocarbons) as well as an aqueous moderator. The main results of these critical experiments and a description of the reactor are included. (M.O.W.)

26428 (AECL-2330, pp 233-50) A STUDY OF THE PHYSICAL CHARACTERISTICS OF HYDROGEN-CONTAINING REACTORS IN THE CRITICAL REGION. Yurova, L. N.; Polyakov, A. A.; Klenov, G. I.; Morosov, I. G.; Inyutin, E. I.; Sidorov, G. I. Translated from pp 194-207 of Issledovaniya po Primeneniyu Organicheskikh Teplonositelei-Zamedlitelei v Energeticheskikh Reaktorakh, Atomizdat, Moscow, 1964.

The results of an experimental comparison of organic and aqueous moderators under identical conditions on a critical stand are presented. In these studies, monoisopropylbiphenyl was used as the organic moderator, the purpose of the experiment being to determine the critical mass of uranium in systems with organic and aqueous moderators for a given construction of fuel elements. The critical stand used is described, and the distribution of thermal neutrons is analyzed. The results show that the values of the migration area for media with monoisopropylbiphenyl lie below the values for aqueous moderators by 40–70% for identical values of QH/Q_5. Measurements were also carried out at different ratios of the active zone to determine the effect of the geometry of the active zone on the critical masses. These investigations showed that in the region where $D_{equiv} \simeq 1$ when $QH/Q_5 = 200$ to 300 for monoisopropylbiphenyl and $QH/Q_5 = 300$ to 400 for aqueous moderators, the values of the critical masses are essentially independent of the geometry of the active zone. (ATD)

26429 (AECL-2330, pp 284-94) DETERMINATION OF THE SPECTRA OF THERMAL NEUTRONS IN A URANIUM-MONOISOPROPYLDIPHENYL LATTICE. Dikarev, V. S.; Mostovoi, V. I. Translated from pp 236-44 of Issledovaniya po Primeneniyu Organicheskikh Teplonositelei-Zamedlitelei v Energeticheskikh Reaktorakh, Atomizdat, Moscow, 1964.

The results of an investigation of the space-energy distribution of thermal neutrons in the core of a uranium-monoisopropylbiphenyl lattice at different temperatures are presented. A comparison is made between these results and the results obtained on a uranium-water lattice. Graphs are given showing the distribution of the neutron "temperature" through the core, the spectrum of neutrons in uranium, the spectrum of neutrons in the moderator, the spectrum of neutrons in uranium in a uranium-monoisopropylbiphenyl lattice, the spectrum of neutrons in the moderator in a uranium-monoisopropylbiphenyl lattice, and the dependence of the neutron "temperature" on the temperature of the medium. The results show that the neutron distribution in a uranium-isopropylbiphenyl lattice is essentially the same as in uranium-water lattice, and that the moderating effect of monoisopropylbiphenyl is essentially independent of the temperature. (ATD)

26430 USE OF NUCLEAR POISONS FOR CRITICALITY CONTROL IN CHEMICAL PROCESSING. Schuske, C. L. (Dow Chemical Co., Denver). Chem. Eng. Progr., 61: Symp. Ser. No. 60, 18-21(1965).

A discussion of a series of neutron multiplication measurements made at Rocky Flats on uranium systems containing boron as a nuclear poison is presented. (L.B.S.)

26431 SOME EFFECTS OF CRITICALITY CONTROL OF CHEMICAL ENGINEERING DESIGN. Kelchner, B. L.; Pinamont, C. J.; Troeltzsch, R. E.; Vandegrift, R. A. (Dow Chemical Co., Denver). Chem. Eng. Progr., 61: Symp. Ser. No. 60, 22-32(1965).

Criticality control considerations often change the design of equipment for chemical processing in the nuclear industry. These changes are brought about primarily to maintain the shape and interrelations of process vessel within the limits provided by criticality physics calculations. These changes may seem relatively minor but are vital to designing equipment which will be safe when processing nuclear materials. Some unique designs for storage vessels, an evaporator, and a dissolver, utilizing safe geometric principles and nuclear poisons to ensure nuclear safety are described. (auth)

26432 CRITICALITY AND NUCLEAR SAFETY OF SLIGHTLY ENRICHED URANIUM. Clayton, E. D.; Brown, C. L. (Battelle Memorial Inst., Richland, Wash.). Contracts AT(45-1)-1350; AT(45-1)-1830. Chem. Eng. Progr., 61: Symp. Ser. No. 60, 33-43(1965).

Fissile materials must be handled in such a manner as to prevent inadvertent criticality outside reactors. Criticality reviews are thus required in fuel element fabrication processes and reactor fuels reprocessing operations involving enriched uranium. Safe mass or volume limits can vary widely subject to the degree of moderation and homogeneity of the uranium-water systems under consideration. In connection with these criticality problems, mass and

volume limits are discussed for slightly enriched uranium solution, solid uranium rods, and uranium tubes (hollow rods), including some comments on criticality problems in handling large billets. Factors affecting criticality are reviewed together with methods of criticality control for uranium with enrichment in the range 0.72 to 5%. (auth)

26433 CRITICAL ARRAYS WITH SUBCRITICAL UNITS OF FISSILE MATERIALS. Thomas, J. T. (Oak Ridge National Lab., Tenn.). Chem. Eng. Progr., 61: Symp. Ser. No. 60, 44-53(1965).

Experiments in support of specifications for the safe storage and transportation of fissile materials are described. The effect of hydrogenous reflectors surrounding arrays, as well as the introduction of moderating materials into arrays, are presented. Other factors influencing the number of units in a critical array are illustrated and an estimate of their magnitude is given. (auth)

26434 REACTIVITY EFFECT OF WATER GAP SPACING, AND ^{238}U ON THE SYSTEM ZIRCONIUM–WATER–^{235}U. Rutledge, G. P.; Condit, C. M.; Dobbe, F. A. (Bettis Atomic Power Lab., Pittsburgh). Chem. Eng. Progr., 61: Symp. Ser. No. 60, 54-69(1965).

The reactivity of single homogeneous systems of zirconium-water-U-235 has been previously developed. This information is quantitatively extended by assessing the reactivity effect that results when homogeneous regions are separated by water gaps, that is, heterogeneous systems. Several fuel regions which are stored adjacent to each other under water do not necessarily represent a maximum reactivity. Since these regions are separated by a water gap, which is often necessary in fuel storage, a maximum peak reactivity is reached at a certain spacing between the regions. It is necessary that this maximum value always be determined before the fuel is handled unless it is mechanically impossible to vary this water gap. (auth)

26435 MEASUREMENT OF INITIAL CONVERSION RATIO IN UO_2–H_2O ASSEMBLY. Nakajima, Tadashi; Tojo, Takao; Kondo, Makoto (Japan Atomic Energy Research Inst., Tokyo). J. Nucl. Sci. Technol. (Tokyo), 3: 89-97(Mar. 1966).

Measurements were made to determine the initial conversion ratio C_0 in a low-power UO_2–H_2O assembly. Special fissile foils were developed for the purpose, and the coincidence counting technique was extended for application to the Al catcher foils used. The conversion ratio obtained was 0.495 ± 0.043. (auth)

26436 METHOD FOR MEASURING ABSOLUTE REACTOR POWER THROUGH NEUTRON FLUCTUATION. Suzuki, Eiji (Nippon Atomic Industry Group Co. Ltd., Kanagawa, Japan). J. Nucl. Sci. Technol. (Tokyo), 3: 98-105(Mar. 1966).

A new principle is presented for obtaining absolute reactor power by processing the random fluctuation of neutron flux based on the stochastic nature of nuclear reactions. The required combination of instruments to carry out experiments is described, and experimental results obtained in a swimming pool reactor are reported. The power spectral density of the output current of an ion chamber located near the reactor core is determined by reactor kinetic parameters such as delayed neutron yield, life time, $\bar{\nu}$ (mean number of neutrons generated per fission) and counter efficiency as well as by the total number of neutrons in the core, which is a measure of absolute power. Using either logarithmic amplifier or reactivity meter, absolute reactor power can be measured without any information about detector efficiency. This method has such merits as easiness and simplicity in operation, ability to measure absolute power in the range 0.01 ~ 100 w where other methods are inapplicable, and negligible effect of changes in core configuration or in detector position. The results of actual reactor experiments with this method proved to agree fairly well with those of absolute measurement by gold foil activation. (auth)

26437 TRANSPORT EFFECTS IN THE P_3 TREATMENT OF CYLINDRICAL RODS IN A SQUARE LATTICE. Dudley, T. E.; Daitch, P. B. Nucl. Sci. Eng., 25: 75-84(1966). (RPI-328-38).

The monoenergetic transport equation is solved in the P_3 approximation for a cylindrical rod in a square cell. Reflecting boundary conditions applied on the boundary of the cell represent exactly the geometry of cylindrical rods in an infinite square-lattice array. By comparison with Monte Carlo calculations, the P_3 calculations appear to approach the exact transport solution at about the same rate in two dimensions as in one dimension. For the cases investigated, the scalar flux in the central absorbing rod is rather independent of the angular position. This appears to be the reason for the success of the Wigner-Seitz equivalent cylindrical cell, with various outer boundary conditions, in predicting flux disadvantage factors. Flux traverses in the square cell and in the Wigner-Seitz equivalent cylindrical cell are also illustrated. (auth)

26438 INFLUENCE OF SOLIDS CHARACTERISTICS ON THE CALCULATION OF THE DOPPLER COEFFICIENT. Froelich, Reinhard; Ott, Karl (Kernforschungszentrums, Karlsruhe, Ger.). Nukleonika, 8: 137-9 (Mar. 1966). (In German).

The effect of solids characteristics on the Doppler coefficient of fast reactors at low temperatures is investigated, and a quantitative evaluation is made using the Debye theory. The effect of a sudden change of the Debye temperature on the phase transition point is discussed. (L.B.S.)

26439 THE OVERLAP EFFECT OF RESONANCES OF DIFFERENT FUEL ISOTOPES IN DOPPLER-COEFFICIENT CALCULATIONS FOR FAST REACTORS. Fischer, Erhard A. (Institut fuer Angewandte Reaktorphysik Kernforschungszentrum, Karlsruhe, Ger.). Nukleonika, 8: 146-8(Mar. 1966).

An expression is derived for the effective cross section for mixtures of two fuel isotopes in fast reactors, which shows that the effect of overlap of resonances causes only a higher order correction in Doppler calculations. For a typical sodium cooled fast breeder core composition of ^{239}Pu and ^{238}U, it was found that the overlap influences both the effective cross sections and their Doppler changes to only 2% or less. (L.B.S.)

26440 PSEUDO-RANDOM IMPULSE RESPONSE METHODS FOR REACTIVITY MEASUREMENTS. Garelis, Edward (Vallecitos Atomic Lab., Pleasanton, Calif.). Nukleonika, 8: 148-51(Mar. 1966).

It is shown that the pseudo-random impulse method with cross correlation between the input and output gives information identical to that given by the repetitive pulsed neutron source technique for long correlation times. This enables one to apply the recent ($k\beta/l$) techniques to these measurements. (auth)

26441 USE OF THE MODIFIED KANTOROWITSCH METHOD FOR DIFFUSION THEORY CALCULATIONS OF THREE-DIMENSIONAL NONSEPARABLE REACTOR GEOMETRIES. Schaeffler, Hermann (Technische Hochschule, Stuttgart). Nukleonika, 8: 163-9(Mar. 1966). (In German).

The modified Kantorowitsch method for the calculation of nonseparable reactor geometries, which was carried out up to now only for two-dimensional problems, is applied to three-dimensional problems. The method is demonstrated by an example of partially driven, eccentric, black control rods in a bare cylindrical reactor. (tr-auth)

26442 VECTORIAL REPRESENTATION OF THE DIFFUSION EQUATION AND MODIFICATION OF PERTURBATION ANALYSIS. Zadworski, Zenon (Aktiebolaget Atomenergi, Studsvik, Sweden). Nukleonika, 8: 169-77 (Mar. 1966).

Long-period observation in different experiments done on heterogeneous systems has indicated that the representation of the diffusion equation should be modified. From the very nature of the subject, there appeared to exist a possibility for the vectorial representation of the diffusion equation, which was investigated and found to be mathematically and physically reasonable. Mathematically then

a factor Θ is evaluated with the physical interpretation of the geometrical anisotropy factor bounded to a system. Perturbation theory is applied to the modified diffusion equation and in order to be sure of the correctness of fluxes used in the statistical weights it was necessary to formulate the perturbation analysis in a more realistic manner. If more than one disturbance is introduced in a reactor there is a coupling effect between them, which is also evaluated but in a hypothetical manner. All calculation concerns bare reactors, but the same formalism can easily be used for reflected reactors too. (auth)

26443 CONNECTION ARRANGEMENT FOR MEASURING THE PERIODS OF NUCLEAR REACTORS. Friedling, Georges; Vaux, Christain (to Commissariat a l'Energie Atomique). German Patent 1,210,499. Feb. 10, 1966. Priority Date Aug. 11, 1961, France.

A periodmeter comprises a neutron ionization chamber, a logarithmic amplifier adapted to receive a current from the chamber and to supply an output voltage proportional to the logarithm of the current, and a differentiating amplifier adapted to supply a voltage proportional to the derivative with respect to time of the voltage issuing from the logarithmic amplifier. The differentiating amplifier is adapted to also effect an auxiliary integration whereby fluctuations of the output voltage are reduced. The integration results in a response time that is continuously and automatically variable both in accordance with the actual period of the reactor and in accordance with the neutron flux.

Design and Feasibility

26444 THE HWOCR'S ROLE IN OPTIMUM NUCLEAR FUEL RESOURCES UTILIZATION. Polak, H. (Atomics International, Geneva). pp 169-77 of Possibilita e Prevedibile Evoluzione dei Tipi di Reattori Sperimentati o in Corso di Sperimentazione. Rome, Comitato Nazionale Energia Nucleare, 1966.

From Conference on Possibility and Foreseeable Development of Experimental Reactor Types, Rome, June 1965.

The technological status of organic-cooled heavy-water-moderated reactors is briefly discussed in connection with the optimum utilization of fuel resources. (D.C.W.)

26445 IMPROVEMENTS IN NUCLEAR REACTORS. Deighton, Thomas (to Babcock and Wilcox Ltd.). British Patent 1,026,474. Apr. 20, 1966. Filed May 23, 1963.

A reactor design is patented that provides for the dissipation of decay heat in a liquid cooled integral reactor. The coolant may be either light or heavy water or organic liquid. The reactor has a neutron shielding tank surrounding the pressure vessel and heat exchange means positioned to be submerged by the shielding liquid within the tank and adapted to dissipate the decay heat by natural circulation through the exchanger of the hot reactor coolant from the reactor vessel. Inhibiting means are provided to control circulation of the reactor coolant. The heat exchangers are made up of tube banks with valves that insure that coolant does not flow while the reactor pumps are in operation. (B.L.M.)

26446 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. Barker, Kenneth; Hopper, Alan Thomas; May, William Charles; Pearce, Norman Denham Brian; Russell, Albert Henry (to United Kingdom Atomic Energy Authority). British Patent 1,026,620. Apr. 20, 1966. Filed Mar. 20, 1964.

A liquid moderated reactor comprises a fuel core consisting of two interleavable parts. The second part is adjustable between two positions, one subcritical and one critical, relative to the first part. In the first subcritical position, the second part of the core is in interleaved relationship with the first part of the core so that the ratio of moderator to fuel in the core results in the reactor being maintained in a subcritical state. In the second critical position, the second part is withdrawn from the first part to allow moderator to be situated between the two parts so that the moderator to fuel ratio in the core results in the reactor being maintained in a critical state. (B.L.M.)

26447 PRESSURE TUBE NEUTRONIC REACTOR AND COOLANT CONTROL MEANS THEREFOR. Hemmerle, Elmer H.; Sadler, John W.; Tower, Stephen N. (to Westinghouse Electric Corp.). U. S. Patent 3,240,678. Mar. 15, 1966. Filed Aug. 22, 1963.

A pressure tube reactor that is gas cooled, particularly steam cooled, is combined with preheating means adaptable for use with either a liquid or gas reactor coolant. This preheating means is associated in heat transfer relation with the moderator structure of the reactor. The heat developed in the moderator chamber of the reactor is employed for drying the inlet steam. Also provision is made for the direct cooling of the pressure tubes so that lower cost structural materials may be used. (B.L.M.)

Fuels

Refer also to abstracts 25330 and 25332.

26448 USE OF STANDARD NUCLEAR DESIGN TECHNIQUES IN CRITICALITY EVALUATIONS. Scarborough, J. C.; McLeod, N. B. (Nuclear Utility Services, Inc., Washington, D. C.). Chem. Eng. Progr., 61: Symp. Ser. No. 60, 9-17(1965).

The need for accuracy and expediency in the analysis of allowable geometries for given fissile and fertile inventories under known moderating conditions for purposes of assuring system subcriticality, such as irradiated nuclear fuel shielded and cooled by water, has led to increased use of conventional nuclear design codes normalized to appropriate critical experimental data. Major application is found in the design of spent fuel shipping casks, spent fuel storage facilities, and fuel reprocessing facility design (dissolver tanks). Additional considerations, such as the complex geometries often encountered, and the desire to conduct economic evaluations of various designs (shipping casks, for example), may make reliance on simple analytical solutions and/or generalized graphical data inappropriate in certain instances. The physical problem of criticality in moderated systems is briefly discussed, various nuclear codes used in such analyses are described, comparisons of predicted and experimental critical data are presented, and an illustrative example is offered. It is concluded that conventional, one-dimensional nuclear codes, with suitable prior normalization to experiment, are a simple and inexpensive answer to many design requirements. (auth)

26449 INSTANTANEOUS COLLAPSE PRESSURES OF GROOVED FUEL ELEMENT CLADDING FOR PRESSURIZED WATER REACTORS. Howl, D. A. (United Kingdom Atomic Energy Authority, Springfields, Eng.). J. Brit. Nucl. Energy Soc., 5: 148-52(Apr. 1966).

The results of instantaneous collapse tests carried out on lengths of grooved PWR fuel element cladding are presented and discussed. The primary aim was to examine the effects of longitudinal grooves suitable for thermocouple location. The results also show that the presence of longitudinal manufacturing defects, such as scratches on the outer cladding surface, will not lower the instantaneous collapse pressure appreciably. The exact calculation of the collapse pressure of grooved cladding is not possible at present, but it is shown that theoretical considerations lead qualitatively to the results obtained. (auth)

26450 DIRECT INVENTORY OF NUCLEAR MATERIAL. Strauss, Sheldon D. Nucleonics, 24: No. 4, 46-51(Apr. 1966).

A summary is given of the methods available for direct inventory of nuclear material at various stages of the fuel cycle. The problem is described, and direct inventory techniques are discussed. These techniques include gravimetric, volumetric, and coulometric techniques, also spectrophotometry, gamma- and x-ray absorptiometry, fluorescence techniques, alpha counting, and polarography. The determination of isotopic composition is described, and dif-

ficult sample assay including unirradiated fuel assemblies, irradiated fuels, and scrap and waste is discussed. (J.F.P.)

26451 FUEL PERFORMANCE AND DEVELOPMENT POTENTIAL. Hardy, U. K. (United Kingdom Atomic Energy Authority, Risley, Eng.). pp 75-86 of Possibilita e Prevedibile Evoluzione dei Tipi di Reattori Sperimentati o in Corso di Sperimentazione. Rome, Comitato Nazionale Energia Nucleare, 1966.

From Conference on Possibility and Foreseeable Development of Experimental Reactor Types, Rome, June 1965.

A brief survey of the development and testing of ceramic and metallic fuels in the United Kingdom is presented. Operating experience is also summarized. (D.C.W.)

26452 IMPROVEMENTS RELATING TO EXTERNALLY FINNED METAL TUBING. Chapman, Thomas Edwin (to Fairey Engineering Ltd.). British Patent 1,023,823. Mar. 23, 1966. Filed Feb. 10, 1961.

Metal tubing having a finned external surface is proposed for heat-exchange purposes, particularly for the fuel cans for nuclear reactors. The metal tubing has a pattern of integral external fins comprising a series of longitudinal rows of oblique spaced parallel fins, each rooted in the curved outer surface of the tubing. The rows extend side by side along and parallel to the length of the tubing and are distributed around its circumference. The lengths of the fins in adjacent rows are of opposite obliquity with respect to the longitudinal axis of the tubing. In each row of fins the axes of cross sectional symmetry of every fin at all points along the length of the fin are parallel to one another and to those of every other fin in the same row. The fin pattern may take various forms, such as longitudinally curved or sinuous; but preferably the fins are straight, substantially planar, and of uniform thickness. (B.L.M.)

26453 IMPROVEMENTS IN OR RELATING TO FUEL ELEMENT CASINGS. Craig, Hugh Robert Morton (to Richardsons, Westgarth and Co., Ltd.). British Patent 1,023,971. Mar. 30, 1966. Filed Dec. 7, 1960.

A method is described to eliminate the chatter due to gas flow of a fuel element casing, either plain or finned, in the channels of a gas cooled reactor. Means are provided on the casing or the channel wall defining a venturi passage and are located to one side of the casing axis between the casing and the wall of the channel. The venturi defining means may be attached to or integral with vanes or splitters, which project radially from the casing or may be located at one end of the casing. (B.L.M.)

26454 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTOR FUEL ELEMENTS. Tatlock, John (to United Kingdom Atomic Energy Authority). British Patent 1,024,123. Mar. 30, 1966. Filed Apr. 2, 1963.

A protective sheath for a fuel member of U or U alloy has coarse-lead helical heat transfer fins and is characterized by radial projections integral with the body of the sheath and spaced longitudinally and circumferentially from one another. These radial projections are adapted to provide means for securing flow splitters to the sheath. (B.L.M.)

26455 IMPROVEMENTS IN OR RELATING TO THE TESTING OF COATED PARTICLES. Hibbert, Neil Silva; Ford, Lionel Houston (to United Kingdom Atomic Energy Authority). British Patent 1,025,109. Apr. 6, 1966. Filed Mar. 16, 1964.

A method of testing the integrity of a coating of a UC kernel coated with another material that is less reactive with air or other oxidizing medium than the UC consists of subjecting the coated particle alternately to air or other oxidizing medium and to vacuum in a high temperature environment and then subjecting the kernels to boiling nitric acid. Any defect in the coating allows penetration of air or other oxidizing medium to the UC kernel to oxidize the UC and produce local expansion in the region of the defect that may be sufficient to burst the coating and reveal the defect. The treatment with boiling acid serves to leach out any oxidized UC through the defect so that the U can be recovered from the solution by conventional means. (B.L.M.)

26456 FUEL ELEMENT UNIT FOR A NUCLEAR REACTOR. Haynes, Ronald (to Babcock and Wilcox Ltd.). German Patent 1,209,221. Jan. 20, 1966. Priority date Aug. 30, 1956, Great Britain.

In a tubular fuel element assembly the cross-sectional area of the coolant passage is reduced progressively from the inlet to the outlet in such a manner as to cause the rate of coolant flow along such passages to vary. This variation maintains an approximately constant fuel temperature throughout the length of the fuel passage. The variation of the cross-sectional area is achieved by enhancing the thickness of the fuel element can progressively from the inlet end to the outlet end. (Gmelin Inst.)

Power and Power-Breeder Reactors

Refer also to abstracts 25129, 25235, 25247–25250, 25266, and 26545.

26457 (ACNP–65541) BORON POISON SYSTEM EVALUATION. Elk River Reactor Operations Analysis Program. Kruzic, T. P. (Allis-Chalmers Mfg. Co., Bethesda, Md. Atomic Energy Div.). July 1965. Contract AT(11-1)-1357. 16p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

The results are presented of a study of the ERR sodium pentaborate system. The main emphasis is directed towards eliminating crystallization of sodium pentaborate; such crystallization has previously caused valve and line blockage. A minor modification to the present system is suggested which would provide for immediate dilution of any pentaborate solution leaking past the closure valves. The suggested additions would be simple and inexpensive. The present solution injection time would be maintained, and no changes to the technical specifications would be required. (auth)

26458 (AGN-TM–415) ARMY GAS-COOLED REACTOR SYSTEMS PROGRAM. ML-1-II FUEL ELEMENT DESIGN REPORT. Soulis, R. E.; English, W. F.; Kimura, L. A.; Wilcox, T. P.; Titus, G. W. (Aerojet-General Nucleonics, San Ramon, Calif.). Jan. 1966. Contract AT (10-1)-880. 223p. Dep. mn. CFSTI $6.00 cy, $1.25 mn.

The developmental and analytical activities associated with the design of the fuel elements for the second core loading (ML-1-II) for the ML-1 reactor are summarized. The design is presented in drawings and a tabulation of design characteristics. The analyses performed to evaluate the design are discussed. The performance specification for the ML-1-II fuel elements and a complete list of fabrication drawings are presented in the appendixes. The mechanical design calculations are also reproduced in the appendix. (M.O.W.)

26459 (BNL–954, pp 1-15) SETTLED-BED REACTOR. (Brookhaven National Lab., Upton, N. Y.).

Research progress on ordered bed, cermet fueled fast breeder reactor is reported. Results are included from studies of neutron physics, fuel technology, and technology of random beds and ordered beds. (J.R.D.)

26460 (CVNA–256) SIX-MONTH OPERATING REPORT, OCTOBER 1, 1965–MARCH 31, 1966. (Carolinas Virginia Nuclear Power Associates, Inc., Parr, S. C.). Contract AT(30-1)-2289. 62p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

Operation of the CVTR at 65 MWf took place over most of the period with a record of over 14 consecutive weeks of 100% availability. Fuel burnup of the original core exceeded design estimates by approximately 12%. Some maintenance of steam plant equipment and cleaning of the superheater necessitated short periods of non-generation of power. Preparation for refueling and the discovery of stress corrosion in part of the sweep gas piping constituted the major portion

of non-routine maintenance. Plant chemistry remained generally within specifications. A peroxide breakthrough occurred in the moderator ion-exchanger, and an increase of anion resin to the original mixed bed is expected to increase capacity some 250%. The normal routine Health Physics coverage was provided by the Operating Group. No unusual or unexpected radiation levels or significant particulate air contamination was found during the period. The average combined total dose of all persons exposed for each quarter was 103 and 194 mrem respectively. The highest individual combined dose for a quarter was only 565 mrem. Comparison of off-site and on-site environmental data shows no significant contribution to the environmental radioactivity resulting from plant operation. (auth)

26461 (EUR-1616.2) EURATOM—ORGEL REFERENCE DESIGN. PARTS I AND II. (Societe Belge pour l'Industrie Nucleaire, Brussels). [nd]. 670p.

A complete detailed description of the Orgel power plant is presented. Included are detailed descriptions on the following: the reactor, fuel handling, main loops, auxiliary loops, reactivity control and instrumentation, secondary systems, electrical systems, buildings, and operation, maintenance, and safety. (M.O.W.)

26462 (GA-5104) TARGET—A PROGRAM FOR A 1000-Mw(e) HIGH-TEMPERATURE GAS-COOLED REACTOR. Quarterly Progress Report for Period Ending February 29, 1964. (General Dynamics Corp., San Diego, Calif. General Atomic Div.). Apr. 1, 1964. Contract AT(04-3)-167. 180p. Dep. mn. CFSTI $5.00 cy, $1.00 mn.

Design studies made during this period on both the prototype and 1000-Mw(e) are reported. Further research on the development of advanced fuels, turbocirculators, fuel cycles, alternate materials of construction, helium purification systems, and components for moisture detection and an acoustic thermometer is reported. (M.O.W.)

26463 (GEAP-5080) DEVELOPMENT PROGRAM ON THE GARIGLIANO NUCLEAR REACTOR. Quarterly Report No. 13. Howard, C. L. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). Jan. 3, 1966. Contract AT(04-3)-189. 21p. (EURAEC-1596). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Work Performed under United States–Euratom Joint Research and Development Program.

The four instrumented fuel assemblies were satisfactorily installed in the reactor, but two had to be temporarily removed to permit reactor repair work. The flux wire guide tubes were removed from three movable in-core flux detector assemblies because the reactor thimbles had a restriction. The fourth assembly cannot be installed for the same reason. The control rod oscillator, electric cables, and recording equipment are installed and ready for trial operation as soon as the core is reloaded. Gamma scan measurements of the power distribution in one octant of the core were completed in October and November. Good agreement was obtained between the measured and predicted values of power distribution. Calculations were made to establish a rod withdrawal sequence for the R and D tests. (auth)

26464 (GEAP-5083) PLUTONIUM SUBCRITICAL EXPERIMENT PROGRAM. Quarterly Report No. 6, October 1–December 31, 1965. Carver, J. G. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). Jan. 3, 1966. Contract AT(04-3)-189. 21p. (EURAEC-1597). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Work Performed under United States–Euratom Joint Research and Development Program.

A brief summary of progress development to date is presented. Further developments on the pressurized water and fuel lattice systems are reported. The plans for future work are outlined. (M.O.W.)

26465 (IDO-28653) ARMY GAS-COOLED REACTOR SYSTEMS PROGRAM. Progress Report, July 1–October 31, 1965. (Aerojet-General Nucleonics, San Ramon, Calif.). Jan. 1966. Contract AT(10-1)-880. 77p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

Testing of the ML-1 reactor in the GCRF was initiated and 214.6 Mwh of operation were accumulated. The reactor was shut down early in August to investigate a leak in the calandria. The total exposure as of this date was 7674.8 Mwh. Analyses were completed to determine the transient temperatures in the ML-1 reactor following a scram of the ML-1/GCRF system. The fabrication of 20 replacement fuel elements for the ML-1-I core loading was completed. The performance evaluation testing of the Stewart-Warner precooler was essentially complete. The effect of the installation of power conversion skid components under the precooler was determined; a significant change in precooler performance was observed when the Griscom-Russell recuperator was installed. System performance analysis of the M-1 system including the CSN-1A(M) t-c set, the Stewart-Warner precooler and the improved recuperator indicated that the net electrical output of the plant at 100°F ambient temperature would be 319.7 kw. The ML-1/GCRF scram response time analysis was completed. The CSN-1A redesign was essentially completed by G. E. Testing of the alternator was completed by Fairbanks-Morse. Testing of the improved lubrication system components was complete and the system was assembled and ready for system tests. (M.O.W.)

26466 (NAA-SR-11202) CALANDRIA REMOTE MAINTENANCE TOOL DEVELOPMENT. Newcomb, L. (Atomics International, Canoga Park, Calif.). Apr. 15, 1966. Contract AT(11-1)-Gen-8. 86p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

Methods were studied and equipment designed for installation and maintenance of process channels and moderator graphite in the calandria core of the large SGR reactor. Development and testing of the conceptual remote-maintenance tooling for separating and sealing top and bottom process tube joints and the tooling for installing moderator graphite were performed. Equipment was designed, manufactured, and tested to determine maintainability of both brazed and welded joints. Tooling was also developed and tested for remote installation of graphite filler logs in the calandria vessel. (auth)

26467 (WCAP-6068) EVALUATION OF MASS SPECTROMETRIC AND RADIOCHEMICAL ANALYSES OF YANKEE CORE I SPENT FUEL. Nodvik, R. J. (Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.). Mar. 1966. Contract AT(30-1)-3017. 181p. Dep. mn. CFSTI $5.00 cy, $1.00 mn.

The results are presented of mass spectrometric, x-ray spectrographic, and radiochemical analyses of spent fuel samples from 219 locations in the Yankee core. These sample locations were preselected to provide: (1) the U and Pu isotopic composition of the fuel as a function of burnup in the asymptotic and perturbed reactor neutron spectra; (2) the spatial distribution of burnup and fuel isotopes in the rods, in the assemblies, and in the core; (3) the total isotopic inventory of the core; and (4) fuel characteristics, including the specific Pu production, the effective capture-to-fission ratio in ^{235}U, and the net mass of fissile materials destroyed per unit of energy release in the fuel. Values of burnup are inferred over a broad range (1,200 to 31,000 Mwd/Mtu) from relationships between U and Pu concentrations measured before and after irradiation, and from the activities of the ^{137}Cs and ^{90}Sr fission products. The calculations used to infer burnup and the various fuel characteristics from the spent fuel data are described in detail. The consistency and reliability of the data are established through the evaluation of the experimental results obtained from a number of interlaboratory cross-check and monitor sample solutions. (auth)

26468 (AECL-2330) RESEARCH ON THE USE OF ORGANIC COOLANT-MODERATORS IN NUCLEAR POWER REACTORS. Aleksenko, Yu. N. (ed.). Translation by Ernest Bock (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.), of Issledovaniya po Primeneniyu Organicheskikh Teplonositelei-Zamedlitelei v Energeticheskikh Reaktorakh, Atomizdat, Moscow, 1964. 300p. Dep. mn. AECL $6.00.

Abstracts were prepared for the 18 included papers. (M.O.W.)

For abstracts of individual papers see: 25126–25129, 25247–25251, 25491, 25492, 26066, 26098, 26427–26429, 26469, and 26470.

26469 (AECL-2330, pp53-62) ORGANIC COOLANTS FOR NUCLEAR REACTORS FROM RESIDUES IN THE MANUFACTURE OF CUMENE. Vol'f-Enshtein, A. B.; Karavaev, G. N.; Krichko, A. N.; Medzhibovskii, B. A. Translated from pp47-55 of Issledovaniya po Primeneniyu Organicheskikh Teplonositelei-Zamedlitelei v Energeticheskikh Reaktorakh, Atomizdat, Moscow, 1964.

The possibility was investigated of obtaining an organic heat-transfer agent whose radiation-thermal resistance would be comparable to that of monoisopropylbiphenyl from the by-products of isopropylbenzene (cumene) production. A polyalkylbenzene resin was used as the raw material. An investigation of the chemical composition of the resin revealed that up to 55% of the hydrocarbons in the resin are derivatives of biphenyl and biphenylalkanes. The boiling point of the resin was 310 to 365°C for fractions obtained at 200 to 300°C. Hydrogenation was carried out in the presence of an Al–Co–Mo catalyst under a hydrogen pressure of 30 to 80 kg/cm^2 at 350 to 390°C. The heat capacity, density, and viscosity were measured within ±2%, ±0.5%, and ±1%, respectively. The decomposition rate of the heat-transfer agent under the simultaneous influence of radiation and temperature was examined in a temperature range of 250 to 400°C. Each test lasted from 20 to 22 hrs. The authors conclude that the rate of formation of polymers under the influence of irradiation is the same for polyalkylbenzene resin and monoisopropylbiphenyl. The transition temperature was 380 to 390°C. In addition, the corrosive activity of this coolant is no different from that of the other fluids investigated. (ATD)

26470 (AECL–2330, pp 71–88) THE USE OF ORGANIC COOLANTS AS WORKING SUBSTANCES IN NUCLEAR POWER INSTALLATIONS. Koryakin, Yu. I.; Loginov, A. A.; Danilin, V. S.; Chernyaev, V. A. Translated from pp 63–77 of Issledovaniya po Primeneniyu Organicheskikh Teplonositelei–Zamedlitelei v Energeticheskikh Reaktorakh, Atomizdat, Moscow, 1964.

The use of organic substances as the working medium of a steam-power cycle, i.e., in single-loop nuclear power plants, was investigated, and an analysis of the thermodynamics is used to illustrate the advantages and peculiarities of biphenyl and benzene. It was found that benzene can be used in condensation circuits under super-critical parameters. The efficiency for benzene and biphenyl circuits was 38–39 and 31–32%, respectively. The use of biphenyl in the reactor and benzene in the steam-power cycle was also found to be efficient. A large heat exchange on the order of 40% was required to increase the thermal economy of the cycles using biphenyl and benzene. It is concluded that the power of turbines with organic heat-transfer agents can be increased to 50 Mw by converting the double-flow design to a reduced number of turns and by increasing the pressure in the condenser. (ATD)

26471 (EURFNR-43F) FAST NEUTRON BREEDER REACTOR "RAPSODIE" SITUATION OF PHYSICS, HYDRAULIC, THERMAL, AND DYNAMICS STUDIES, AND STUDIES OF STABILITY EARLY IN 1963. (Commissariat a l'Energie Atomique, Paris (France)). Translation of report CEA-R-2450. 117p. Dep. mn. CFSTI $4.00 cy, $0.75 mn.

Work Performed under United States-Euratom Fast Reactor Exchange Program.

A series of hydraulic, dynamics, physics, stability, and thermal studies that were carried out for Mo-Pu-U and PuO_2-UO_2 cores is summarized. (D.C.W.)

26472 (EURFNR–77F) SAFETY AND COST ANALYSIS OF A 1000-MWe SODIUM-COOLED FAST POWER REACTOR. Smidt, D.; Frisch, W.; Giordano, P.; Heusener, G.; Kessler, G.; Krewer, K. H.; Merk, W.; Malmberg, T.; Schonfeld, E. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronenphysik und Reaktortechnik). Translation of report KFK–398. 40p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Work Performed under United States–Euratom Fast Reactor Exchange Program.

The Karlsruhe group completed a design study of a 1000-Mw(e) sodium-cooled fast breeder reactor at the end of 1964. A detailed safety and cost analysis was made and is presented. The dynamics and safety of the reference reactor are described. Parametric studies were made to determine influences on cost and safety. Results are discussed. (M.O.W.)

26473 (ACNP–65524(Rev.1)) POWER ESCALATION THROUGH FULL POWER OPERATION. Topical Report No. 2 on Operation of the Elk River Reactor, January 1963–October 1964. (Allis-Chalmers Mfg. Co., Bethesda, Md. Atomic Energy Div.). Revised Feb. 1966. Contract AT(30-1)-2639. 46p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

The testing and operation carried out to ensure safe escalation to full power in the ERR are described. The operating characteristics of the reactor are also discussed. (M.O.W.)

26474 THE ORGEL PROJECT. Leny, J. C. (EURATOM, Ispra, Italy). Atompraxis, 12: 224; 227-31(Apr.-May 1966). (In Italian).

The purpose of the ORGEL project, the execution of which was entrusted to Euratom by the six Member States of the European Community in 1960, is to investigate a heavy-water moderated and organic-liquid (polyphenyl mixture) cooled power reactor type. Studies were made to obtain a better knowledge of the materials to be used (organic coolants, structural materials) and to develop a simple and cheap fuel element (uranium carbide). These studies were adjudged sufficiently advanced for the construction of an ORGEL prototype reactor. Details of the ORGEL design with certain useful comparisons with other heavy-water types are given. (P.C.H.)

26475 THE PROSPECTS OF NUCLEAR POWER IN THE ITALIAN ECONOMY. FROM THE FIRST REPORT BY THE ENERGY ADVISORY COMMITTEE. Comit. Naz. Energ. Nucl., Notiz., 12: 24-31(Feb. 1966). (In Italian).

The prospects for the use of nuclear power in Italy are briefly discussed, and the status of the development of nuclear power in Italy is summarized. (D.C.W.)

26476 ITALIAN REACTORS AS OF JANUARY 1966. Comit. Naz. Energ. Nucl., Notiz., 12: 49-56(Feb. 1966). (In Italian).

The major specifications of the reactors that were in operation, under construction, or in the design stage as of January 1966 are tabulated. (D.C.W.)

26477 INDUSTRIAL NUCLEAR POWER PLANS IN SWEDEN. Abadie-Maumert, F. A. Energ. Nucl., 8: 82-5(Mar. Apr. 1966).

Equipped with a nuclear research establishment at Studsvik and a semi-industrial power reactor at Farsta, Sweden is entering the industrial phase of nuclear development. Because of the abundance of low-grade uranium resources, the effort undertaken mainly centers on reactor types that use natural or slightly enriched uranium fuel and heavy water moderator. Two projects programmed are the Ranstad uranium refinery (120 tons per year) and the nuclear power station at Marviken (200 Mw), which will also generate superheated heavy water steam. Another project is a pressurized heavy water reactor rated for 265 Mw. (auth)

26478 ON-LINE COMPUTER ALARM ANALYSIS. Kay, P. C. M. (A.E.I. Automation Ltd., Knutsford, Eng.). Ind. Electron., 4: 50-3(Feb. 1966).

An on-line computer alarm-analysis system was recently supplied to the nuclear power station at Oldbury-on-Severn. The monitoring requirements of such a plant are discussed, and the various operating techniques of the alarm scanning, checking, and indicating equipment being used are described. (TCO)

26479 COMPETITIVE NUCLEAR POWER. Cockcroft, John. J. Brit. Nucl. Energy Soc., 5: 36-48(Jan. 1966).

The emergence of competitive nuclear power is considered. This was a gradual process which started at Harwell fifteen years ago when the possibility of nuclear power based on a graphite moderated, CO_2 cooled reactor was discussed. This process culminated, in Britain, in the acceptance of the 1200 MW AGR by the Central Electricity Generating Board as the first competitive nuclear power station. The AGR is discussed in some detail and its future potential considered. Developments in other countries, notably the USA, and alternative systems in this country are also considered. (auth)

26480 THE LICENSING OF NUCLEAR POWER REACTORS IN THE UNITED STATES. Kingsley, S. G. (United States Atomic Energy Commission). J. Brit. Nucl. Energy Soc., 5: 49-59(Jan. 1966).

The position of the United States Atomic Energy Commission within the Federal Government, its organizational arrangements and procedures for the licensing of nuclear power reactors, and the substantive criteria of safety which it employs are discussed. A section on the licensing of individual reactor operators is included. The Commission's regulatory doctrine is reviewed, and the prospects of more explicit elaboration in its regulations of regulatory standards are considered. (auth)

26481 IRRADIATION TRIALS OF MAGNOX FUEL ELEMENTS. Horsley, R. M. (United Kingdom Atomic Energy Authority, Annon, Scotland). J. Brit. Nucl. Energy Soc., 5: 88-9(Jan. 1966).

The testing of critical factors in magnox fuel elements is described. The fuel element test conditions and performance are given, and safety is considered. The fuel element conditions in the magnox reactors, design conditions in fuel element irradiation trials, and irradiation levels in fuel elements are tabulated. (J.F.P.)

26482 THE USE OF A COMPUTER IN THE DESIGN OF AN ADVANCED GAS-COOLED REACTOR SYSTEM: A PARAMETER SURVEY CODE. Black, G. (National Computing Centre, London); Cutts, B.; Pearson, J. F. J. Brit. Nucl. Energy Soc., 5: 90-102(Jan. 1966).

In designing an advanced gas cooled reactor a great many calculations must be carried out in order to investigate the performance and economics of each conceptual design. While some of these calculations can be made with great accuracy others are of an empirical nature either because of inadequate data or because some phenomena are not well understood. With the use of a modern high speed digital computer it was possible to prepare a program which will carry out the whole of the main performance calculations for any given conceptual design based on appropriately chosen data. By using simple formulas where these are adequate the whole of the evaluation for any one case can be carried out in about one minute exclusive of the input and output times which themselves total about two minutes. The incorporation of automatic comparisons within the computer program enables a range of parameters to be examined and a local optimum sought. (auth)

26483 THE USE OF COMPUTERS IN THE CONTROL AND INSTRUMENTATION OF CENTRAL ELECTRICITY GENERATING BOARD NUCLEAR POWER STATIONS. Hiorns, D. S.; Jervis, M. W. (Central Electricity Generating Board, London). J. Brit. Nucl. Energy Soc., 5: 103-13(Jan. 1966).

The application of data loggers and digital computers in CEGB Nuclear Power Stations is examined. The historical development leading to the present situation is reviewed and notes on future developments are included. The specific application of computers to problems of alarm analysis and display are discussed and a typical computer application is described. The effect on control room design of the introduction of computer control is discussed. (auth)

26484 EXPERIMENTAL BASIS OF REACTOR PHYSICS PREDICTIONS FOR STEAM GENERATING HEAVY WATER LATTICES. Campbell, C. G.; Johnstone, I. J. Brit. Nucl. Energy Soc., 5: 168-203(Apr. 1966).

The 100 Mw(e) prototype steam generating heavy water reactor is now nearing completion at AEE Winfrith and is scheduled to go critical in 1967. An extensive series of zero energy physics experiments has been carried out in support of this project, and the techniques adopted for the early experiments designed to obtain an understanding of the basic lattice physics of SGHW reactors are described in some detail in this paper. It is shown that the accuracies to which the various parameters must be measured are determined by the need to limit the uncertainty in the void coefficient of reactivity to ±0.02 or less and that this aim has been achieved by the techniques adopted. (auth)

26485 CALCULATION OF THE GRAPHITE WEIGHT-LOSS IN CIVIL MAGNOX AND ADVANCED GAS-COOLED REACTORS. Standring, J. (United Kingdom Atomic Energy Authority, Culcheth, Eng.). J. Nucl. Energy, Pt. A/B, 20: 201-17(Mar. 1966).

When graphite is used as the moderator in CO_2-cooled reactors it sustains a radiation-induced oxidation which can lead to significant loss of weight, especially in highly rated systems. The factors which determine the rate of oxidation are examined and incorporated into a general equation. It is shown how to calculate the oxidation rate when graphites with different porosities from Grade A are used and also when the CO_2 coolant contains additives which inhibit in-pile oxidation. The variation of oxidation rate within the core as a whole and within a single unit cell is considered in detail, thus making it possible to estimate the rate in such important regions as fuel element sleeves and channel walls near to peak-rated fuel. Since oxidation occurs within the pores of the graphite, with a consequent increase in porosity, the rate will accelerate with burn off. Equations are developed to allow for this effect when calculating the cumulative weight loss. Finally, to illustrate the methods described, worked examples are presented for C and a typical Civil A.G.R. (auth)

26486 APPARATUS TECHNOLOGY ESPECIALLY FOR CONTROL ARRANGEMENTS OF POWER REACTORS. Reber, J. (Landis and Gyr AG, Zug, Switzerland). Neue Tech., 8: 100-6(Mar. 1966). (In German).

The principal arrangement of the control system of large power reactors is recapitulated. The influence of different magnitudes, such as temperature and flow of the cooling medium and neutron flux, on the manipulated variable, as e.g., control rod position or absorber concentration, is discussed. The in-core instruments, such as those for the measurement of temperature or neutron flux, are described on the basis of planned and realized installations. The procedure of measuring the neutron flux, which is unconventional compared with the measurement of temperature and flow, is dealt with. The purpose consists not only in gaining average values, but also in obtaining the actual repartition over the whole core. This is important in order to obtain regular burnup of all fuel elements on the one hand, and to avoid, especially in large reactors, hot spots and local flux oscillations, on the other. Future tendencies are estimated. (auth)

26487 DOPPLER EFFECT MEASUREMENTS IN PLUTONIUM-FUELED FAST POWER BREEDER REACTOR SPECTRA. Fischer, G. J.; Meneley, D. A.; Hwang, R. N.; Groh, E. F.; Till, E. Nucl. Sci. Eng., 25: 37-46 (1966).

Doppler effect measurements were made in two plutonium-fueled fast reactor assemblies at the ZPR-3 reactor. One assembly, Assembly 45A, mocked up a large plutonium-uranium monocarbide fast-power-breeder reactor having a ^{239}Pu-to-^{238}U ratio of 1:7. The second assembly, Assembly 45, had a considerably softer spectrum, produced by replacing 40% of the canned sodium of the previous assembly by graphite. Zone-loading techniques were used to achieve these mockups. Doppler measurements were made with samples containing highly enriched ^{239}Pu, ^{239}Pu, and ^{238}U mixed in a ratio of 1:7, as in a large breeder reactor, and ^{238}U in two rod diameters. Various check experiments were performed to test the validity of the measurements. The experimental results showed a strong negative Doppler response for ^{238}U, in good agreement with theoretical estimates. The ^{239}Pu in the mixed isotope fuel composition gave only a small Doppler contribution. A separate mea-

surement for ^{235}U in the power breeder spectrum was positive and in reasonable agreement with theory. The ^{239}Pu results were the most interesting. Three degrees of increasing "hardness" of neutron energy spectrum incident upon the ^{239}Pu Doppler element were generated by Assembly 45, Assembly 45A, and Assembly 45A with nonradioactive B_4C surrounding the Doppler element, respectively. The experimental positive ^{239}Pu Doppler effect reactivity change was much smaller than calculated for the softest spectrum. The agreement between theory and experiment improved significantly, however, as the neutron energy spectrum hardened. (auth)

26488 POSSIBILITA E PREVEDIBILE EVOLUZIONE DEI TIPI DI REATTORI SPERIMENTATI O IN CORSO DI SPERIMENTAZIONE, ATTI DEL X CONGRESSO NUCLEARE ORGANIZZATO, ROMA, 24–25 GIUGNO 1965. (Possibility and Foreseeable Development of Experimental Reactor Types, Proceedings of the 10th Nuclear Congress, Rome, 24–25 June 1965). Rome, Comitato Nazionale Energia Nucleare, 1966. 480p. (CONF-650671).

Separate abstracts were prepared for each of the 23 papers included. (G.O.Y.)

For abstracts of individual papers see: 26444, 26451, 26489–26508, and 26545.

26489 DEVELOPMENT EFFORTS OF THE U.S. CIVILIAN NUCLEAR POWER PROGRAM. Giambusso, A. (Atomic Energy Commission, Washington, D. C.). pp 39-53 of Possibilita e Prevedibile Evoluzione dei Tipi di Reattori Sperimentati o in Corso di Sperimentazione. Rome, Comitato Nazionale Energia Nucleare, 1966.

From Conference on Possibility and Foreseeable Development of Experimental Reactor Types, Rome, June 1965.

The status of civilian nuclear power plants in the United States is summarized. The development of advanced converters, breeder reactors, and nuclear desalination is discussed. (D.C.W.)

26490 NUCLEAR REACTOR DEVELOPMENT IN THE UNITED KINGDOM. Brown, G. (United Kingdom Atomic Energy Authority, Risley, Eng.). pp 55-71 of Possibilita e Prevedibile Evoluzione dei Tipi di Reattori Sperimentati o in Corso di Sperimentazione. Rome, Comitato Nazionale Energia Nucleare, 1966.

From Conference on Possibility and Foreseeable Development of Experimental Reactor Types, Rome, June 1965.

A brief survey of the development and status of power reactors in the United Kingdom is presented. (D.C.W.)

26491 THE DEVELOPMENT TYPES LINE OF POWER REACTORS IN FRANCE. Vendryes, G. (CEA, Saclay, France). pp 87-94 of Possibilita e Prevedibile Evoluzione dei Tipi di Reattori Sperimentati o in Corso di Sperimentazione. Rome, Comitato Nazionale Energia Nucleare, 1966. (In French).

From Conference on Possibility and Foreseeable Development of Experimental Reactor Types, Rome, June 1965.

The development of graphite-moderated gas-cooled reactors, of heavy water reactors, and of fast-breeder reactors for nuclear power plants in France is briefly discussed. (G.O.Y.)

26492 CONCEPTUAL DESIGN OF A NATURAL URANIUM BOILING LIGHT WATER REACTOR. Krenz, F. H. (Atomic Energy of Canada Ltd., Chalk River, Ont.). pp 95-118 of Possibilita e Prevedibile Evoluzione dei Tipi di Reattori Sperimentati o in Corso di Sperimentazione. Rome, Comitato Nazionale Energia Nucleare, 1966.

From Conference on Possibility and Foreseeable Development of Experimental Reactor Types, Rome, June 1965.

A 500-Mw(e) power plant that uses a light-water-cooled, heavy-water-moderated, natural-uranium reactor is described. The results of analytical studies of the plant are presented. (D.C.W.)

26493 THE ORGEL LINE. Leny, Jean-Claude (EURATOM-CCR, Ispra, Italy). pp 119-35 of Possibilita e Prevedibile Evoluzione dei Tipi di Reattori Sperimentati o in Corso di Sperimentazione. Rome, Comitato Nazionale Energia Nucleare, 1966. (In French).

From Conference on Possibility and Foreseeable Development of Experimental Reactor Types, Rome, June 1965.

The general characteristics of the ORGEL line of reactors (organic-cooled, heavy-water-moderated) are outlined, and the economics of an ORGEL power plant are discussed. Some of the technological problems in designing and testing the channels for the organic fluid are discussed also. The prototype ESSOR is mentioned as an example. (G.O.Y.)

26494 OBJECTIVES OF THE DON PROGRAM IN SPAIN. Pascual, F.; Palacios, L.; Velarde, G. (Junta de Energia Nuclear, Madrid). pp 137-49 of Possibilita e Prevedibile Evoluzione dei Tipi di Reattori Sperimentati o in Corso di Sperimentazione. Rome, Comitato Nazionale Energia Nucleare, 1966.

From Conference on Possibility and Foreseeable Development of Experimental Reactor Types, Rome, June 1965.

The objectives of the DON reactor program in Spain are outlined along with some of the development problems, the prospects for participation of the Spanish industry, and some of the economic considerations. (G.O.Y.)

26495 THE EVOLUTION OF PROVEN NUCLEAR POWER REACTOR CONCEPTS IN THE FEDERAL REPUBLIC OF GERMANY. Guck, Rudolf W. (Badenwerk AG., Karlsruhe, Ger.). pp 151-66 of Possibilita e Prevedibile Evoluzione dei Tipi di Reattori Sperimentati o in Corso di Sperimentazione. Rome, Comitato Nazionale Energia Nucleare, 1966.

From Conference on Possibility and Foreseeable Development of Experimental Reactor Types, Rome, June 1965.

The various reactor concepts which form the basis of the nuclear power program of the Federal Republic of Germany are briefly described; and the development program is outlined including the nuclear power demonstration plant program, the medium-range program for advanced converters, and the long-range development program for fast and thermal breeders. (D.C.W.)

26496 HIGH TEMPERATURE GAS-COOLED REACTORS. de Hoffmann, F.; Rickard, C. L. (General Atomic Div., General Dynamics Corp., San Diego, Calif.). pp 179-93 of Possibilita e Prevedibile Evoluzione dei Tipi di Reattori Sperimentati o in Corso di Sperimentazione. Rome, Comitato Nazionale Energia Nucleare, 1966.

From Conference on Possibility and Foreseeable Development of Experimental Reactor Types, Rome, June 1965.

Some developments in high-temperature gas-cooled reactors in the United States are discussed. Discussions on component development, fuel development, and fuel-cycle studies are included, as well as some conclusions from preliminary tests at the completed Peach Bottom HTGR. The role of fast gas-cooled breeder reactors is also discussed. (G.O.Y.)

26497 MODERN STEAM TECHNOLOGY APPLIED TO WATER REACTORS. Edlund, M. C.; Vannoy, W. M. (Babcock and Wilcox Co., Lynchburg, Va.). pp 195-203 of Possibilita e Prevedibile Evoluzione dei Tipi di Reattori Sperimentati o in Corso di Sperimentazione. Rome, Comitato Nazionale Energia Nucleare, 1966.

From Conference on Possibility and Foreseeable Development of Experimental Reactor Types, Rome, June 1965.

The evolution of steam conditions for water reactor systems is discussed with emphasis on the present capability and short-term potential of the Babcock and Wilcox PWR System and the long-range goals for the Steam-Cooled Breeder Reactor. (G.O.Y.)

26498 DESIGN FEATURES OF THE MODERN PRESSURIZED WATER REACTOR. Abbott, W. E.; Farbman, G. H.; Beckjord, E. S.; Widdoes, L. C. (Westinghouse Electric Corp., Pittsburgh). pp 205-27 of Possibilita e

Prevedibile Evoluzione dei Tipi di Reattori Sperimentati o in Corso di Sperimentazione. Rome, Comitato Nazionale Energia Nucleare, 1966.

From Conference on Possibility and Foreseeable Development of Experimental Reactor Types, Rome, June 1965.

The evolution of the pressurized-water reactor (PWR) is discussed, and the status of the PWR is summarized. The future development of the PWR is also briefly considered. (D.C.W.)

26499 THE SCOTT-R AND ITS PLACE ON THE ELECTRIC UTILITY SYSTEM. Jones, A. R.; Wright, J. H. (Westinghouse Electric Corp., Pittsburgh). pp 229-49 of Possibilita e Prevedibile Evoluzione dei Tipi di Reattori Sperimentati o in Corso di Sperimentazione. Rome, Comitato Nazionale Energia Nucleare, 1966.

From Conference on Possibility and Foreseeable Development of Experimental Reactor Types, Rome, June 1965.

The Supercritical Once-Thru Tube Reactor (SCOTT-R) is described and is compared with other advanced converter reactors. The status of the SCOTT-R development program is also summarized. (D.C.W.)

26500 THE 1965 BOILING WATER REACTOR. Richards, R. B. (General Electric Co., San Jose, Calif.). pp 251-64 of Possibilita e Prevedibile Evoluzione dei Tipi di Reattori Sperimentati o in Corso di Sperimentazione. Rome, Comitato Nazionale Energia Nucleare, 1966.

From Conference on Possibility and Foreseeable Development of Experimental Reactor Types, Rome, June 1965.

A review of the technology of boiling-water reactors, as typified by Dresden No. II, is presented; and the future development of the boiling-water reactor is briefly discussed. The Dresden No. II power plant is described in some detail. (D.C.W.)

26501 NUCLEAR SUPERHEAT PROGRESS. Lampe, D. A.; Burwell, S. B. (Allis-Chalmers Mfg. Co., Bethesda, Md.). pp 265-80 of Possibilita e Prevedibile Evoluzione dei Tipi di Reattori Sperimentati o in Corso di Sperimentazione. Rome, Comitato Nazionale Energia Nucleare, 1966.

From Conference on Possibility and Foreseeable Development of Experimental Reactor Types, Rome, June 1965.

The zero-power critical tests and the preoperational system tests that were carried out on the PATHFINDER reactors are summarized, and the future test program is outlined. The future of nuclear superheat is also briefly discussed. (D.C.W.)

26502 DESIGN AND COST TRENDS IN CANADIAN HEAVY WATER REACTOR STATIONS. Beck, R. L. (Canadian General Electric Co., Ltd., Peterborough). pp 281-301 of Possibilita e Prevedibile Evoluzione dei Tipi di Reattori Sperimentati o in Corso di Sperimentazione. Rome, Comitato Nazionale Energia Nucleare, 1966.

From Conference on Possibility and Foreseeable Development of Experimental Reactor Types, Rome, June 1965.

The bases for the decision to concentrate on heavy-water-cooled and -moderated reactors are outlined, and a number of recent design improvements are described. The trends of costs and development are also briefly discussed. (D.C.W.)

26503 EXPERIENCE WITH INTEGRAL GAS COOLED REACTORS. Vaughan, R. D. (Nuclear Power Group, Knutsford, Eng.). pp 333-43 of Possibilita e Prevedibile Evoluzione dei Tipi di Reattori Sperimentati o in Corso di Sperimentazione. Rome, Comitato Nazionale Energia Nucleare, 1966.

From Conference on Possibility and Foreseeable Development of Experimental Reactor Types, Rome, June 1965.

The design and construction of the concrete vessel for the graphite-moderated gas-cooled reactor at Oldbury are discussed. A short discussion of the unique features of the boilers and the gas blowers is also given. (G.O.Y.)

26504 DEVELOPMENT AND POTENTIALITIES OF THE HIGH TEMPERATURE PEBBLE BED REACTOR CONCEPT. Mueller, H. W.; Lupberger, A. (Brown Boveri/Krupp Reaktorbau GmbH, Duesseldorf, Ger.). pp 317-31 of Possibilita e Prevedibile Evoluzione dei Tipi di Reattori Sperimentati o in Corso di Sperimentazione. Rome, Comitato Nazionale Energia Nucleare, 1966.

From Conference on Possibility and Foreseeable Development of Experimental Reactor Types, Rome, June 1965.

The status of the development of high-temperature pebble-bed reactors is summarized, and the future development of the concept is briefly discussed with emphasis on the economic aspects. (D.C.W.)

26505 THE PARTICIPATION OF INDATOM IN EL-4 AND IN ADVANCED PROJECTS OF POWER REACTORS. Gibrat, R. (Indatom, Paris). pp 345-52 of Possibilita e Prevedibile Evoluzione dei Tipi di Reattori Sperimentati o in Corso di Sperimentazione. Rome, Comitato Nazionale Energia Nucleare, 1966. (In French).

From Conference on Possibility and Foreseeable Development of Experimental Reactor Types, Rome, June 1965.

The role of Indatom in the preliminary planning and the actual construction of the EL-4 is outlined. The role Indatom is playing in other advanced power reactor projects is also discussed. (G.O.Y.)

26506 THE CIRENE PROGRAM. Silvestri, M. (CISE, Milan). pp 365-76 of Possibilita e Prevedibile Evoluzione dei Tipi di Reattori Sperimentati o in Corso di Sperimentazione. Rome, Comitato Nazionale Energia Nucleare, 1966.

From Conference on Possibility and Foreseeable Development of Experimental Reactor Types, Rome, June 1965.

The CIRENE program for the development of a heavy-water-moderated reactor that uses natural uranium as fuel and pressurized water as coolant in direct cycle with the turbine is discussed. (D.C.W.)

26507 FEATURES OF THE BOILING HEAVY WATER REACTOR, BHWR. Sundqvist, C.; Skygge, C. G.; Tenerz, E. (ASEA, Vaesteraes, Sweden). pp 377-91 of Possibilita e Prevedibile Evoluzione dei Tipi di Reattori Sperimentati o in Corso di Sperimentazione. Rome, Comitato Nazionale Energia Nucleare, 1966.

From Conference on Possibility and Foreseeable Development of Experimental Reactor Types, Rome, June 1965.

The development and features of the boiling heavy water reactor are briefly discussed. The use of prestressed-concrete pressure vessels and nuclear superheat with boiling heavy water reactors is briefly considered. (D.C.W.)

26508 EVALUATION STUDIES FOR AN EXPERIMENTAL SUPERCRITICAL PRESSURIZED WATER REACTOR. Kunz, W.; Oszuszky, F. J. P. (Austrian Electricity Generating Board, Vienna). pp 393-401 of Possibilita e Prevedibile Evoluzione dei Tipi di Reattori Sperimentati o in Corso di Sperimentazione. Rome, Comitato Nazionale Energia Nucleare, 1966.

From Conference on Possibility and Foreseeable Development of Experimental Reactor Types, Rome, June 1965.

The development of a pressurized-water reactor in which supercritical steam is produced is briefly discussed. A description of a pressurized-water reactor with a supercritical experimental loop is presented. (D.C.W.)

26509 NUCLEAR POWER PLANT. Parker, Horace Frank; Webb, John (to United Kingdom Atomic Energy Authority). British Patent 1,026,559. Apr. 20, 1966. Filed Oct. 11, 1963.

An arrangement is patented for a nuclear reactor plant in which the heat exchangers are arranged in a bank on one side of the reactor or in two banks on opposite sides of the reactor rather than the usual arrangement in a ring around the reactor. The heat exchangers and the reactor along with

a common coolant reservoir are enclosed in a common elongated structure. The heat exchangers of a bank are connected in parallel to a coolant output duct extending radially to the reactor. Adjacently situated and associated with each exchanger is a coolant pump, and the pumps for a bank of exchangers are connected in parallel to a coolant input duct extending radially of the reactor. The exchangers are arranged to discharge coolant into the common reservoir, and the pumps withdraw coolant from the reservoir. (B.L.M.)

26510 IMPROVEMENTS IN ENERGY PRODUCING PLANT INCLUDING A REACTOR OF THE BOILING WATER TYPE. (to Societe Francaise des Constructions Babcock and Wilcox). French Patent 1,190,224. Oct. 9, 1959. Filed Jan. 17, 1958.

The invention is chiefly based on the application and adaptation to plants equipped with a reactor of the so-called double-circulation method. The reactor is divided by an inner partition into two stream-generating compartments enclosing corresponding sections of the reactor core; the second compartment supplies the turbine with driving steam and receives as a return from the latter the feed water through the agency of a condensing device inside by which the steam produced in the first compartment is condensed through contact with feed water. A permanently operating draining connection is established for the water corresponding to the second compartment towards the water corresponding to the first compartment and a purifying system is inserted in parallel with the circuit feeding water for the first compartment. By reason of this arrangement, the water contained in the second compartment is subjected to a continuous draining. The steam feeding the turbine benefits by lowering of the concentration of impurities which reduces considerably the radioactive contamination of the turbine and of associated parts. The concentration of the impurities rises to a considerable extent in the first compartment, which forms a distilling system with the condenser device. (IIB)

26511 FUEL ELEMENT ASSEMBLY FOR A NUCLEAR REACTOR. McNelly, Malcolm J. (to U. S. Atomic Energy Commission). U. S. Patent 3,238,105. Mar. 1, 1966.

A fuel-element assembly for a liquid-metal-cooled, high-energy (fast) neutron, breeder reactor is described. The fuel-element assembly comprises basically a fissile-fuel section with breeder-blanket sections at each end and a venting system for fission-product-gases exhausting outside the reactor core. Heat sink barriers are disposed transversely in the fuel element to prevent central melting. (AEC)

26512 STEAM PRODUCING REACTOR AND FUEL THEREFOR. Campbell, Keith W.; Roberts, John M.; Imhoff, David H.; Pennington, Robert T. (to U. S. Atomic Energy Commission). U. S. Patent 3,243,351. Mar. 29, 1966.

Boiling water reactors and fuel elements therefore are described. The fuel element comprises boiler rods for generating saturated steam and process tubes for superheating the steam in conjunction with integrally arranged mixing and water separation plenum means for the generated steam. (AEC)

26513 PANCAKE REACTOR. Grover, George M. (to U. S. Atomic Energy Commission). U. S. Patent 3,243,613. Mar. 29, 1966.

A reactor employing thermionic conversion wherein fuel plates and coolant (or collector) plates are stacked, end and side reflectors are utilized, and the coolant plate utilizes condensable vapor and capillary means within itself, the capillary means being capable of causing the transport of condensed vapor from a cooler area of the container to a hotter area is described. (AEC)

Process Heat Reactors

26514 (ORNL-tr-1173) OPTIMUM DIMENSIONING OF DUAL-PURPOSE PLANTS FOR THE PRODUCTION OF DESALINATED WATER AND ELECTRICITY WITH THE USE OF NUCLEAR ENERGY. Gaussens, J. (Commissariat a l'Energie Atomique, Paris (France)). Translated for Oak Ridge National Lab., Tenn., from paper presented at IAEA 5th Panel on the Utilization of Nuclear Energy in Water Desalination, [1965]. 33p. Dep. mn. JCL $3.60 fs, $1.19 mf.

An economics study was made for the nuclear production of desalinated water. Separate discussions are presented on the following; shape of the demand curves, the characteristics of supply and principles of adaptation of supply and demand. (M.O.W.)

Production Reactors

26515 (DUN-SA-7) CAPSULE IRRADIATION IN HANFORD PRODUCTION REACTORS. Bowers, C. E. (Douglas United Nuclear, Inc., Richland, Wash.). Apr. 15, 1966. Contract AT(45-1)-1857. 5p. (CONF-660511-2). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From International Symposium on Capsule Irradiation Experiments, Pleasanton, Calif.

A review of test irradiations conducted at Hanford is presented. General irradiation descriptions, unique capsules and irradiations, reactor characteristics and experiments, and test analyses are briefly described. (M.O.W.)

Propulsion and Space

See also ENGINEERING — Space Propulsion

Refer also to abstract 25278.

26516 (AED-C-22-05) BIBLIOGRAPHIEN ZUR KERNFORSCHUNG UND KERNTECHNIK. SEKTION 22: KERNENERGIEANTRIEBE FUER SCHIFFAHRT. (Bibliographies in Nuclear Science and Technology. Section 22: Nuclear Ship Propulsion). Paro, J. N. (comp.) (Zentralstelle fuer Atomkernenergie-Dokumentation, Gmelin-Institut fuer Anorganische Chemie und Grenzgebiete, Frankfurt am Main (West Germany)). Feb. 1966. 38p. Dep. mn.

Approximately 125 articles on various aspects of nuclear ship propulsion are listed. (M.O.W.)

26517 (IDO-17126) STEP PROJECT. Quarterly Technical Report, January 1965–March 1965. Curet, H. D. (ed.) (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). Mar. 1966. Contract AT(10-1)-205. 59p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

The period beginning January 1, 1965 and ending March 31, 1965 represents a quarter in which the Nuclear Safety Technology Engineering and Test Branch conducted SNAPTRAN-1 transient tests, performed analytical studies for SNAPTRAN-1, -2, and LOFT, and determined the design characteristics for a Zircaloy-clad core. The SNAPTRAN-1 impulse drives were performance tested to obtain the operational characteristics of the transient impulse drum drives. Upon completion of the performance tests, transient tests were performed on the SNAPTRAN-1 reactor using impulse reactivity insertions. Included in the SNAPTRAN-1 analytical studies was the evaluation of the reliability of mathematical models for predicting the direct gamma radiation hazards associated with short reactor transients. The SNAPTRAN-2 analytical studies were concerned with predicting the behavior of the SNAPTRAN-2 reactor during the destructive test. The LOFT analytical studies involved the determination of mathematical models that will predict the behavior of the LOFT reactor and its components when subjected to the phenomena of core meltdown, metal–water reactions, and blowdown. Nuclear studies associated with the design of a Zircaloy-clad core for LOFT were performed in order that the characteristics of a Zircaloy-clad core could be compared with those of the LOFT-designed stainless-steel-clad core. (auth)

26518 (IDO-17145) STEP PROJECT. Quarterly Technical Report, April 1965–June 1965. Dietz, K. A.

(ed.) (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). May 1966. Contract AT(10-1)-205. 115p. Dep. mn. CFSTI $4.00 cy, $0.75 mn.

The SNAPTRAN program during this period consisted primarily of transient testing of the SNAPTRAN-1 reactor. The tests, performed to determine the kinetic behavior of fast response SNAP reactors, were conducted using two-drum impulse, two-drum step, and one-drum impulse reactivity insertions. The tests in the two-drum impulse series were conducted with reactivity insertions up to a maximum of 4.2 dollars without violating the criteria for nondamage testing. The single-drum impulse test data reported in IDO-17126 were analyzed. The analysis, which was primarily scoped to provide an evaluation of the feedback reactivity, was performed using three distinct methods of feedback analysis. The latter two of these methods were found to yield much more accurate values of the feedback coefficient than are available from the first or more standard method. Design and analysis efforts on the LOFT facility and experimental system included the design of a halogen and particulate filter system, the design of a fission product sampling system, and the analysis of the blowdown and water-hammer forces on the primary coolant system and the reactor flatcar or dolly. The structural analysis of the primary coolant system and of the dolly was performed through the quasi-steady-state analytical approach. This analysis was appreciable for a conservative evaluation of the LOFT experiment, but a more vigorous treatment was found desirable for design purposes. Zirconium-clad critical assemblies were reviewed, and the design of the LOFT core was modified to reflect the change from stainless steel fuel cladding to zirconium fuel cladding. A point-to-average power distribution was obtained, and a control rod ejection accident analysis and a metal–water reaction analysis were made for the Zircaloy-clad core. An analytical model for describing the pressure and temperature within the containment vessel was developed as part of the design and safety analysis of a water-cooled nuclear reactor plant. An IBM-7040 computer code was also developed to perform the analysis of a loss-of-coolant accident. A modification to the code was investigated to allow the code to be used to predict the pressure-temperature history within a pressure-suppression-type containment vessel in response to a loss-of-coolant accident. The explicit pin model of heat transfer during meltdown and the steam separation model of two-phase blowdown were evaluated through numerical computations. The blowdown of a vessel typifying the LOFT vessel as calculated using the steam-separation model. As part of the radiological effort, contamination-decontamination studies were conducted to determine the behavior of fission products on various coating materials, and Zircaloy-clad fuel samples were analyzed to determine the structural changes occurring during melting. Wet chemistry separation and absorption of iodine on boron nitride were investigated and evaluated as possible methods of fission product analysis. The detailed design of the continuous sampler-monitor was initiated. Instrumentation studies were conducted in which new measurement techniques were investigated and evaluated, and measuring devices were developed that have capabilities beyond those of the standard state-of-the-art devices. Insulating materials were evaluated in an autoclave to determine their resistance to high-temperature, steam–water environments. The materials tested were found incapable of withstanding temperature in excess of 600°F. A drag-disk flowmeter was developed for measuring point flow velocity and total flow. A model of the flowmeter was tested in a flow loop and found acceptable for liquid flows. Gamma-ray attenuation techniques were investigated as a means of measuring fluid desntiy in the coolant piping. The investigation indicated that a low-energy, gamma-ray source would be required to make a fluid density measurement in the coolant piping used for the semiscale LOFT blowdown test. Instrumentation studies were also conducted in which a SNAPTRAN-1 fuel pin was pressurized and the circumferential expansion measured for pressures up to and exceeding 2000 psi. (auth)

26519 (N–66-15495) AN ACOUSTICAL STUDY OF THE KIWI B NUCLEAR ROCKET. Manhart, J. Kenneth; Ailman, C. M.; Lane, S. R.; Marsh, A. H. (Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.). Jan. 1966. Contract NASw-596. 122p. (NASA-CR–370). CFSTI $4.00 cy, $1.00 mn.

Sound pressures generated by the exhaust of the KIWI B nuclear rocket engine were measured, and the data were analyzed. The characteristics of the radiated sound field that were identified include the: distribution of sound pressures with frequency; distribution of radiated sound power with frequency and total radiated sound power; directivity characteristics; conversion efficiency of exhaust mechanical stream power to sound power; space-time correlation of sound pressures in the near field; and probability distribution of instantaneous peak pressures. These characteristics were related to the flow parameters of the KIWI B exhaust and, where relevant, to acoustical data and flow parameters of chemical rocket engines. A method of normalizing the sound power spectra is introduced because the conventional methods did not satisfactorily relate the acoustical data from the KIWI B and chemical rocket engines. On the basis of two data sets from power runs of the KIWI B reactor, the acoustical conversion efficiency of the KIWI B exhaust is shown to be lower than for chemical rockets. In the near-field, the distribution of instantaneous peak pressures was found to be approximately Gaussian. In addition, the response of simple structures to the KIWI B sound field was studied. Comparisons of measured and analytically derived response were made. (STAR)

26520 (NASA-CR–447) STABILITY OF COUPLED-CORE NUCLEAR REACTOR SYSTEMS [Thesis]. Murray, Hugh S.; Weaver, Lynn E. (Arizona Univ., Tucson). May 1966. 103p. CFSTI $4.00 cy, $0.50 mn.

An investigation was made of two or more separate power reactors coupled together for the purpose of achieving an increased system power output. It is necessary from a practical standpoint to discover whether or not a projected coupled-core system is inherently stable. If, for example, a system of clustered nuclear rocket engines is operating at design power conditions, hopefully the system, if perturbed from the operating point, returns to its original state. This is the fundamental problem of the asymptotic stability of an autonomous or undriven system. Recently, researchers have found that the most universal method of investigating the stability of ordinary differential equations is the Second Method of Liapunov. It is natural, therefore, to derive a technique based upon Liapunov's theory for this problem. The Second Method is directly applicable to nonlinear equations. The presence of the time delay, however, necessitates some modifications to the Liapunov approach. The extension of the method is based upon the work performed by Driver, Krasovskii, and Razumikhin on the mathematical features of equations with delay. The time delay is incorporated directly into the Second Method, thus it is certain that the results are conservative due to the sufficiency of the stability conditions. The modified approach is based upon comparing all possible solutions of a system with delay with the known properties of the system without delay. The technique used is to find quadratic Liapunov functions for the linearized, zero delay system. Stability conclusions can then be made for the linearized system with delay. Finally, the nonlinear terms are added to estimate the regions of stability of the state variables. (M.O.W.)

26521 (NASA-CR–54848) SNAP-8 ELECTRICAL GENERATING SYSTEM DEVELOPMENT PROGRAM. Semiannual Progress Report, January–June 1965. Report No. 3053. (Aerojet-General Corp., Azusa, Calif.). Aug. 1965. Contract NAS 5-417. 367p.

SNAP-8 is a turboelectric, nuclear, space power conversion system using a mercury Rankine cycle. The system incorporates three liquid metal loops. The development progress of the power conversion system (turbine-alternator assembly, pump-motor assemblies, boiler, condenser, and electrical controls) during the first half of 1965 is discussed. A 320-hr continuous test in a rated-power test loop was completed. During this test,

50 kw or above was produced throughout a 170-hr period. Since November 1964, the turbine-alternator assembly has operated for 830 hr, including 44 starts. Testing in the first complete system loop was started on 28 May. Once stable loop operation was achieved, boiler testing was started. Steady-state operation is stable. (auth)

26522 SPECIALIZED SHIPS OF THE NUCLEAR AGE. Davis, A. W. J. Brit. Nucl. Energy Soc., 5: 16-18(Jan. 1966).

The advantages of using nuclear power for ship propulsion are considered. Diesel- and nuclear-powered refrigerated cargo ships are compared for dimensions, weights, speed, and operating costs. Passenger liners are also compared for conventional-turbine and nuclear-power advantages. Improvement in reactor design for ship propulsion is discussed as being necessary to the success of nuclear propulsion. (J.F.P.)

26523 NUCLEAR POWERED SHIPS: A SHIPOWNER'S VIEWPOINT. Munton, R. J. Brit. Nucl. Energy Soc., 5: 19-21(Jan. 1966).

The use of nuclear-powered ships is considered from a ship owner's point of view. The various costs resulting from the use of nuclear power are discussed. Other factors are also mentioned. It is concluded that there is no economic reason for fitting a nuclear installation at this time. (J.F.P.)

26524 NUCLEAR POWERED SHIPS: THE SHIPPER'S INTEREST. Hughes-Hallet, J. J. Brit. Nucl. Energy Soc., 5: 22-3(Jan. 1966).

The advantages of nuclear-powered ships are considered. The main factor in using nuclear power is economic. Low freights and safe swift voyages from the use of nuclear power are discussed. The economics of fast cargo transit special requirements for handling nuclear ships, disadvantages, and characteristics of nuclear ships are considered. (J.F.P.)

26525 PORT FACILITIES AND REQUIREMENTS FOR NUCLEAR POWERED SHIPS. Finnis, S. A. J. Brit. Nucl. Energy Soc., 5: 24-6(Jan. 1966).

The differences between the requirements for nuclear vessels and the traditional type of ship, both from the cargo handling point of view and the precautions necessary against nuclear hazard while vessels are in port are examined. How far can the requirements be met by the docks of today, or is a new type of port necessary? Provided suitable precautions are taken and public anxiety allayed, there seems no reason why nuclear vessels employing conventional handling methods cannot be dealt with at many of the existing berths. Progress will need to be made and statutory powers will be necessary before nuclear vessels become a regular feature of port operations. (auth)

26526 NUCLEAR MERCHANT SHIPS: INTERNATIONAL REQUIREMENTS AND SAFETY ASPECTS. Whiteside, H. N. E. J. Brit. Nucl. Energy Soc., 5: 27-9 (Jan. 1966).

The present international requirements concerning the safety of nuclear merchant ships agreed at the 1960 Safety and Life at Sea Convention. The probable lines of development of nuclear marine propulsion could not be forecast at the time and a number of broad recommendations covering safety aspects was agreed and forms an annex to the Act of the Conference. Some of the probable safety requirements for the first British nuclear ships are briefly considered in the light of present day developments, and manning of the ships is discussed. The hazards arising from the use of conventional and nuclear fuels are referred to and some general comments concerning design and construction are offered for consideration. (auth)

26527 CLASSIFICATION SOCIETY REQUIREMENTS FOR NUCLEAR SHIPS. Pemberton, H. N. (Lloyd's Register of Shipping, London). J. Brit. Nucl. Energy Soc., 5: 30-2(Jan. 1966).

The requirements for a nuclear ship starting with hull materials, hull strength and collision and grounding protection, together with the shock requirements for both hull and machinery are reviewed. Rules relating to the construction of primary circuit pressure parts and both integral and independent containment structures are summarized and, where acceptable, the methods of over-pressure relief are outlined. Brief survey of reactor engineering and reactor control criteria are followed by a review of those general requirements particularly relevant to the ship environment, plant maintenance and periodic inspection. (auth)

26528 CONSOLIDATED NUCLEAR STEAM GENERATOR (A PART OF REPORT ON NUCLEAR MERCHANT SHIPS). Smith, W. R.; Thomas, C. E. (Babcock and Wilcox Co., Inc., Lynchburg, Va.). Nucleonics, 24: No. 4, 39-42; 45(Apr. 1966).

The performance of the NS Savannah is described. The engineered safeguards, port entry, and reactor containment effectiveness are discussed. From this design performance the development of advanced design is considered. The design of the CNSG is described. This includes the reactor core, fuel elements, pressure vessel, steam generator, primary pumps, pressurizer, pressure-suppression containment, and nuclear instrumentation. The specifications for the NS Savannah and the CNSG are given. (J.F.P.)

26529 BIOLOGICHESKAYA ZASHCHITA SUDOVYKH REAKTOROV. (Biological Shielding for Maritime Reactors). Broder, D. L.; Popkov, K. K.; Rubanov, S. M. Leningrad, Izdatel'stvo Sudostroenie, 1964. 412p.

The physics of interactions of radiation with matter, radiation effects on the human organism, dosimetry principles, and characteristics of materials used in shielding are considered. Sources of penetrating radiation in nuclear reactors and effects of the source geometry on the spatial distribution of radiation are discussed, and neutron spatial-energy distributions, gamma attenuation, gamma capture and heat release, radiation penetration through shielding channels, and activation of construction materials are studied. Methods for calculating biological shielding are described, and constants needed for the calculations are presented. Specific radiation safety controls for nuclear ships are treated, and the design and installation of shielding for maritime reactors are considered. Examples of practices used in domestic and foreign shipbuilding are given. (M.J.T.)

Research and Test Reactors

Refer also to abstract 26476.

26530 (AECL–2415) THE DEVELOPMENT OF STEAM–WATER REACTOR LOOPS AT CHALK RIVER. Horsman, J. C. (Atomic Energy of Canada Ltd., Chalk River (Ontario)). Apr. 1966. 17p. (CONF-660521–1). Dep. mn. AECL $0.75.

From International Symposium on In-Pile Irradiation Equipment and Techniques, Harwell, Eng.

A small pressurized-water loop in NRX, X-4, was modified in 1960 to provide for cooling with superheated steam. It was redesigned in 1962 to also accommodate boiling water and fog coolant. Several problems in steam generation, control stability, degassing, out-leakage and pumping were overcome. The experience with X-4 provided a basis for the design of a large steam-water loop, U-1, that was added to the NRU reactor in 1964; this system handles from 1 to 4 Mw of nuclear heat, depending on the cooling mode. These two loops are now fully operational and, in most respects, meet the requirements. U-1 has excellent control stability over a range of conditions. It is difficult to degas to low concentrations, and persistent leakage from small valves is also a continuing problem. Improvements are needed in design and in component reliability to reduce complexity, maintenance and capital costs. Both loops are described. (auth)

26531 (AECL–2420) HEALTH PHYSICS PLANNING FOR CHANGING THE NRU REACTOR VESSEL. Bush, William R. (Atomic Energy of Canada Ltd., Chalk River (Ontario)). Apr. 1966. 35p. (CONF-660520–1). Dep. mn. AECL $1.00.

From International Symposium on the Decontamination of Nuclear Installations, Harwell, Eng.

The NRU Reactor vessel is corroding slowly, and eventually it will have to be replaced. The radiation hazards expected during the replacement and the corresponding precautions that will have to be taken are discussed. Before starting any phase of the vessel change, personnel will be briefed on the specific hazards to be expected and the precautions to be taken. Dummy runs will be made with a full-size model before the radioactive vessel is handled. A difficult planning problem will be reconciling the available man-Rem of exposure with the man-Rem of exposure required during the seven-month vessel change operation. The vessel change will provide an opportunity to obtain health physics information and experience, and to reappraise the worth of devices such as alarming dosimeters, the respirator fit-test apparatus, and the mobile change and shower room. (auth)

26532 (ANL–6962) EXPERIMENTS WITH PERIPHERAL SUPERHEATER CORE PSH-1, BORAX-V. Rice, R. E. (ed.) (Argonne National Lab., Ill.). July 1965. Contract W-31-109-eng-38. 287p. Dep. mn. CFSTI $6.00 cy, $1.50 mn.

After power operation of central superheater core CSH-1 was suspended because of superheater fuel failures due to fabrication and repair difficulties, the central superheater core and core structure were removed from the BORAX-V reactor vessel and replaced with the peripheral superheater core and structure. To prevent reoccurrence of the difficulties with the central superheater assemblies, the peripheral superheater fuel assemblies were repaired, modified, inspected, and tested before installation in the reactor. The BORAX-V reactor, containing a core with a peripherally located superheater, PSH-1, was successfully operated from April through August 1964. This marked the first prolonged operation of an integral boiling water-nuclear superheating reactor in the United States. Both boiler and superheated fuel performance in this core was excellent. A minimum program of zero-power and power experiments was carried out with the core with the peripheral superheater. The zero-power experiments included control-rod calibrations, measurement of superheater flooding reactivity worth, and available excess reactivity at room and operating temperatures. In addition, the temperature coefficient of reactivity, boric acid reactivity worth, power distribution, cadmium ratios, etc. were measured. The experimental program at power included the achievement of power and steam temperature in excess of the original design values; the successful test operation and demonstration of the special reactor and steam systems that are required for an integral boiling-nuclear superheating reactor; power distribution, in-core instrumentation, and transfer-function measurements; and power split, water chemistry, and prepared, defective-fuel experiments. Natural recirculation of coolant water was used throughout these experiments. (M.O.W.)

26533 (BNL–954, pp 16-49) REACTOR PHYSICS DIVISION. Chernick, J.; Kouts, H. (Brookhaven National Lab., Upton, N. Y.).

Research progress is summarized on neutron thermalization, neutron transport in fast and intermediate systems, reactor kinetics, fluid dynamics, and sphere packing. Results of theoretical studies on heavy-moderator resonance absorption, neutron transport in slabs, resonance capture in clustered lattices, fuel cladding effects on Dancoff factor, and neutron thermalization are included along with results of thoria-urania lattice measurements. Research at the reactor physics critical facility is reported. Investigations of pulsed fast reactors are described, and research on direct conversion is summarized. Evaluations of lead bromide direct conversion, remote electric drives, turbine systems, transuranium element production methods, production of ^{60}Co and Po, and rotating fluidized bed reactors are reported. Work on neutron cross sections is summarized. (J.R.D.)

26534 (BNL–10139) BROOKHAVEN HIGH FLUX BEAM REACTOR: DESIGN AND USE. Kouts, Herbert J. (Brookhaven National Lab., Upton, N. Y.). Apr. 1966. Contract AT(30-2)-Gen-16. 27p. (CONF-660312–5). Dep. mn. CFSTI $2.00 cy, $0.50 mn.

From Nederlands Atoomforum, Utrecht.

The Brookhaven High Flux Beam Reactor was designed to fulfill research needs of the Brookhaven research staff. It was therefore intended to provide neutron beams to a variety of kinds of experiments, with an emphasis on solid state physics. There are nine neutron beam facilities, of which five have been assigned to diffractometer studies of solid state structure, one is to be used with a fast chopper in measurements of resonance strength functions, one is to be used with a slow chopper in cold neutron inelastic scattering experiments, one is devoted to the scattering of polarized neutrons from polarized crystals, and one is given to capture gamma-ray experiments. In addition, there are four fast neutron irradiation facilities and three isotope irradiation facilities. The maximum thermal neutron flux available in the reflector at the design power of 40 megawatts is in excess of 7×10^{14} neutrons/cm^2 sec. The basis of the design, the features of the reactor, and the performance to date are described. (auth)

26535 (ORNL–TM–1401) NEUTRON FLUCTUATION SPECTRA IN THE OAK RIDGE RESEARCH REACTOR. Stephenson, S. E.; Roux, D. P.; Fry, D. N. (Oak Ridge National Lab., Tenn.). May 3, 1966. Contract W-7405-eng-26. 24p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Measurements were made of the power spectral density of fluctuating current from a neutron-sensitive ionization chamber in the ORR. The spectra contain a constant component which is attributed to the detection process and a frequency-dependent component which is produced by reactor forcing functions whose nature was investigated during this work. The magnitude of the frequency-dependent component is directly proportional to the square of reactor thermal-power level. This frequency-dependent component is also observed to be a function of reactor coolant flow rate. Spectra are compared for different reactor neutron detection efficiencies. The effect of detection efficiency on the observed power spectral density confirms previous investigation. An analysis is made of reactivity, coolant flow rate, and coolant inlet temperature fluctuations as driving function sources. Further investigation is warranted. (auth)

26536 (ORNL–TM–1503) OAK RIDGE RESEARCH REACTOR QUARTERLY REPORT, OCTOBER–DECEMBER OF 1965. Tabor, W. H.; Hurt, III, S. S. (Oak Ridge National Lab., Tenn.). Apr. 14, 1966. Contract W-7405-eng-26. 36p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

The ORR operated 87.7% of the time during the quarter, accumulating 2411 Mwd at an average power level of 29.9 Mw. The quality of the reactor water was markedly improved by the addition of a demineralizer in series with the degasifier. With the present piping scheme, any water transferred from the reactor system to the pool system, during operation, will first be degassed and demineralized. Unusual, but relatively small, power oscillations occurred on November 20, 1965. These oscillations were found, after considerable investigation, to be caused by slight shim-rod vibration; and the south upper-shim-rod bearing (hold-down arm) was replaced. Vibration of the shim rods was greatly reduced. Instrument performance remained excellent, with a considerable improvement in the previously troublesome log-N channels. The second ^{241}Am target was installed in the core (position D-2) on October 21, 1965. Measurements in this facility indicate a very satisfactory flux level; however, adjacent experiment facilities suffered a slight flux depression. A new, quick-opening access cover was installed on the reactor tank. This cover will result in a savings of about one hour of reactor downtime each shutdown. (auth)

26537 (STI/DOC–57) UTILIZATION OF RESEARCH REACTORS. VOLUMES I AND II. Proceedings of a Study Group Meeting, Sao Paulo, 4–8 November 1963. (International Atomic Energy Agency, Vienna (Austria)). 1965. 982p. (CONF-631104). Dep. mn. IAEA.

Ninety-one papers on different applications of research

reactors are presented. Most of the papers are presented in their entirety, however, some are included only as abstracts. (M.O.W.)

26538 (STI/DOC-58) UTILIZATION OF RESEARCH REACTORS. VOLUMES I AND II. Proceedings of a Study Group Meeting, Manila, 9–13 December 1963. (International Atomic Energy Agency, Vienna (Austria)). 1965. 790p. (CONF-523). Dep. mn. IAEA.

Forty-four papers are presented on the following: reactor startup and initial measurements; study of reactor characteristics; reactor operation, maintenance, and safety problems; organization for operation and supporting facilities and services; health physics and waste disposal; production of radioisotopes, and activation analysis. (M.O.W.)

26539 THE EURATOM RESEARCH CENTRE AT ISPRA. Ritter, G. (EURATOM, Ispra, Italy). Atompraxis, 12: 208-12; 15(Apr.-May 1966). (In Germany).

In autumn 1960 Euratom began to expand Ispra Nuclear Research Center, which it had taken over from the Italian Government, into the largest Research Center in the Community. This expansion can now be considered as complete within the limits assigned under the First and Second Five-year Programs. Only the large test-reactor ESSOR is still under construction and will go critical in the year 1967. The following individual research facilities are ready: Reactor ISPRA-1; EXPO, a subcritical assembly for core-studies with variable lattice pitch in a heavy-water moderator; ECO, a critical assembly constructed under the ORGEL program; the ESSOR reactor; the Computer Center with the electronic computers IBM-7090, IBM-1401 (two), IBM-1620, IBM-1301 (two), PACE 231 R.E.A. (three); and a medium-activity laboratory. The major tasks at ISPRA can be divided into four groups, namely: the ORGEL program; own work (work not connected with this program); participation in other Euratom programs; scientific and technical support for work under the other programs. Altogether Euratom has a staff of 1167 under the Euratom statute as well as 401 other employees. Since the establishment of a staff of 1900 (excluding auxiliaries) originally envisaged for 1967 was reduced in the middle of the expansion phase to 1700 (including auxiliaries), an imbalance ensued in the staffing of many laboratories, reflected in a serious shortage of technicians and auxiliary staff. (auth)

26540 THE RANA REACTOR AT THE CASACCIA CENTER. Foli, U.; Sassoli, C.; Zona, R. Comit. Naz. Energ. Nucl., Notiz., 12: 33-7(Feb. 1966). (In Italian).

The Rana (reactor for neutron analysis in water) reactor, which was originally operated as the Ispra-2, is briefly described. (D.C.W.)

26541 RAPSODIE SIMULATOR: PURPOSE AND DESIGN. Cambe, H.; Chareton, H.; Levallet, H.; Paziaud, A. (CEN, Cadarache, France). Energ. Nucl., 8: 94-103(Mar.-Apr. 1966). (In French).

The simulator has two distinct sections: a control room including a full-scale drawing of the Rapsodie board, 1 cabinet with safety circuits, meters, and various relays, and 1 monitoring desk for technical operators' schools; and an engine room, where the reactor itself is simulated with its thermal section (core, heat exchangers, pipe-system lagging) as well as the neutron section. The control and measurement circuits are also simulated. Several simulation programs were carried out for a critical study of the desk design, and then for studies on starting procedure. The different possibilities of using the simulator are reviewed. A study of the control of air flow in the final exchanger, study of a power stabilizer, and studies on breakdowns are considered. (auth)

26542 ARGONNE AUTOMATIC NEUTRON DIFFRACTOMETER. Johanson, Edward W. (Argonne National Lab., Ill.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci., NS-13: 69-73(Apr. 1966).

The electronic control and data handling for the automatic neutron diffractometer installed at the CP-5 research reactor is discussed. (B.G.D.)

26543 RESEARCH REACTOR FAULT ANALYSIS, PART 1. Moore, J. C. (Atomic Energy Research Establishment, Harwell, Eng.). Nucl. Eng., 11: 195-6; 199-202(Mar. 1966).

A system of fault record and analysis that was introduced into the Plant Engineering Group of the Research Reactors Division at AERE Harwell is outlined, and some results obtained using this system are summarized. (D.C.W.)

26544 INHERENT DYNAMIC BEHAVIOR OF FAST ZERO POWER REACTORS IN REACTIVITY DISTURBANCES. Engelmann, P. (Kernforschungszentrum, Karlsruhe, Ger.). Nukleonika, 8: 152-9(Mar. 1966). (In German).

The dynamic behavior of fast zero-power reactors composed of individual bricks with slope disturbances was investigated using an analog computer. Fast disturbances, which lead to the prompt critical region, are well described by the analytical solution of W. Häfele. For slow disturbances, which are sustained below prompt critical three phases can be distinguished in the excursion course, the second of which is characteristic for zero-power reactors of these types. The second phase reduces the size of the inherently controllable reactivity disturbances by a factor of approximately 0.5. (tr-auth)

26545 THE D_2O-REACTOR PROJECTS MZFR AND AKB. Keller, W. (Siemens-Schuckertwerke AG, Erlangen, Ger.). pp 353-63 of Possibilita e Prevedibile Evoluzione dei Tipi di Reattori Sperimentati o in Corso di Sperimentazione. Rome, Comitato Nazionale Energia Nucleare, 1966.

From Conference on Possibility and Foreseeable Development of Experimental Reactor Types, Rome, June 1965.

The heavy-water-moderated and -cooled MZFR reactor, which uses a pressure vessel, and the AKB project, which involves a pressure-tube reactor that is cooled by CO_2 and is moderated with heavy water, are described. (D.C.W.)

26546 EXPERIENCE WITH THE USE OF PRESSURE AND LEVEL GAGES IN A FAST-REACTOR SYSTEM. Petrenko, A. A. Priborostroenie, No. 1, 23-5(1965).

Some modifications of previously developed pressure and level gages for Na and NaK coolants to make them suitable for use in a BR-5 fast reactor are described. The temperature range of an RUM-type radio-wave level gage, was raised from 250 to 350°C by replacing the gage's seal, which made it suitable for coolant temperatures up to 500°C. The reliability of a potentiometer-type level gage was increased by replacing the sectional construction of the sensor (tube) with a simple stainless-steel tube with a 1-mm wall thickness. The use of steam for maintaining a constant temperature for an MEM-3-M pressure gage was replaced by electric heating, thus simplifying the gage's design and preventing the contact of steam with Na or NaK. The modified pressure gage was found to be suitable for coolant temperatures up to 500°C. Some future trends in development of instruments for measuring Na and NaK parameters are discussed. (ATD)

26547 PROCESS FOR THE STRATIFICATION OF A BODY OF LIQUID IN TWO SUPERPOSED LAYERS AND INSTALLATION FOR THE APPLICATION OF THE PROCESS. (to Commissariat a l'Energie Atomique). French Patent 1,360,279. Mar. 31, 1964. Filed Mar. 26, 1963.

The basic concept of the process is to prevent mixing of superposed layers of liquid in a swimming pool reactor without the use of a partition and to prevent the diffusion of the layer of contaminated water in the other layer. The liquid of the two layers is circulated in a continuous manner and a suitable temperature difference maintained between the flows of water delivered to the two layers. A slight excess flow is delivered to the top layer. The water from the bottom layer is withdrawn, cooled, and reinjected into the bottom layer. The water from the top is withdrawn, mixed with the withdrawn bottom water, and the mixture decontaminated. It is then heated to a temperature higher than that of the water that is reinjected into the bottom layer and reinjected into the top layer. (IIB)

WASTE DISPOSAL AND PROCESSING

See *also* BIOLOGY AND MEDICINE — Ecology
CHEMISTRY — Radiochemistry
CHEMISTRY — Separation Processes and Procedures
HEALTH AND SAFETY

Refer also to abstract 24971.

26548 (AE-225) THE RADIOACTIVE WASTE MANAGEMENT AT STUDSVIK. Hedlund, R.; Lindskog, A. (Aktiebolaget Atomenergi, Stockholm (Sweden)). Apr. 1966. 14p. Dep. mn.

Various operations associated with the management (collection, transport, treatment, discharge, storage, and operational monitoring) of: radioactive liquid wastes, except high-level effluents from reactor fuel recovering operations; solid wastes, except those produced from treatment of high-level wastes; gaseous wastes produced from treatment of the foregoing liquid and solid wastes; and equipment decontamination facilities and radioactive laundries are discussed. Economics are considered. (P.C.H.)

26549 (NP-15915) ANNUAL REPORT ON RESEARCH CONTRACT NO. 201/RB, JULY 1963–JUNE 1964 (WITH ONE ANNEX). (Institut "Rudjer Boskovic," Zagreb (Yugoslavia)). 58p. Dep. mn.

Progress is reported in studies on the biological consequences of the disposal of radioactive wastes into the Adriatic Sea. Data are presented from laboratory studies on the metabolism of ^{22}Na, ^{65}Zn, ^{56}Co, ^{57}Co, ^{58}Co, ^{90}Sr, and ^{90}Y in fishes, shrimps, mussels, and other selected marine invertebrates maintained in standing or running seawater. The concentration factor for ^{22}Na in some fishes and mussels, when plotted against time, showed on exponential rise, indicating an exchange of ^{22}Na from seawater with the Na atoms available in the organisms. The periodic shedding of the old cuticle in the moulting cycle of some crustaceans and the formation of the new one was found to involve extensive changes in mineral metabolism and result in 20 times the amount of Ca or Sr in hard shelled as in recently moulted specimens. Results are included from preliminary studies on mechanisms involved in mineral metabolism, the effects of salinity of extracellular fluid on mineral uptake, the effects of the physico-chemical state of fission products in seawater on uptake, and ^{14}C tracer studies of the relation between hydrochemical conditions and primary plankton productivity in the vicinity of Rovinj. (C.H.)

26550 FEASIBILITY OF USING SOILS FOR LOW-RADIOACTIVITY WASTE-WATER PURIFICATION. I. ^{60}Co ADSORPTION BY PEATS. Verdnikov, A. I.; Oreshko, V. F. (Moscow Inst. of Medicine). Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol., 7: 594-7(1964).

The adsorption of ^{60}Co by peat from aqueous solutions as a function of the type and degree of decomposition of the peat and of the ^{60}Co concentration and pH of the solution was studied. The significance of studies of radioactive contamination of environment and the danger inherent in peats owing to their high sorption capacity were noted. The ^{60}Co sorption was carried out batchwise at 30°C from $CoCl_2$ solutions (radioactivity, 2.6×10^4 to 2.6×10^5 cpm) with 5 types of peat. All the peats exhibited good sorption of ^{60}Co from solution. The maximum sorption rate was shown by samples of two types of peat having low (10%) and average (50%) degrees of decomposition. The radioactivity level had practically no effect on the sorption process. The maximum sorption dependence on the pH was in the pH range from 5.0 to 8.0. It was concluded that peats are cheap natural sorbents suitable for the purification of low-radioactivity waters. (ATD)

26551 WASTE DISPOSAL. Fineman, P. Reactor Fuel Process., 9: 40-50(Winter 1965–1966).

Treatment of low- and intermediate-level-activity wastes by ion exchange and freeze drying is discussed. Conversion of high-level-activity wastes to solids by fluid-bed calcination or conversion to gasses is described. Final disposal methods are considered including perpetual tank storage of high-level-activity wastes. Fission product recovery is also also considered. (32 references). (M.C.G.)

26552 RADIOISOTOPE DIFFUSION IN BASALT. Ralkova, J. (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Rez). Silikaty, No. 1, 12-24(1965).

Glass and molten rock were found to be excellent and economical materials to render insoluble highly radioactive wastes, such as spent fuel from reactors, which radiates tens of kilocuries/kg and is usually highly acid. Four types of basalt found in Czechoslovakia at Hollberg, Tesetice, Dolanky, and Oharice were studied in detail and that from Tesetice was found to absorb ions most rapidly in the resolidified form. Specimens were prepared by melting crushed basalt at 1350 to 1450°C, tempering for two hours at 650°C and then cooling gradually for 24 hr to room temperature. Small plates $20 \times 20 \times 1$ mm were cut and ground smooth. Drops of a ^{137}Cs or ^{90}Sr solution were placed on such plates and the escape of radioisotope prevented by heating to 600°C, cooling, and washing with nitric acid in distilled water. The plates with radioactive cesium were then placed in a small muffle furnace and the heat steadily raised from 440°C, while measuring the radiation at specific intervals with a beta G-M tube. Radiation from similar ^{90}Sr specimens was measured and recorded after deducting pulses caused by the accompanying ^{90}Y. Each specimen was tested without a filter and then with an aluminum filter of 124 mg/cm^2, which absorbed all ^{90}Sr rays and half the ^{90}Y rays. Radiation rates of the two isotopes in basalt were charted at temperatures from 440 to 850°C and found to be on the order of 10^{-3} up to 600°C for cesium and 660°C for strontium, with 10^{-2} at higher temperatures. The diffusion coefficients of each isotope in basalt and in glass were tabulated and charted, as well as their absorption curves in aluminum. As the temperature rose from 440 to 850°C, the diffusion coefficients varied from around 10^{-13} to 10^{-11}. The physical and chemical properties of Tesetice basalt were also studied in relation to heat treatments ranging from 650 to 1000°C, and x-ray studies were made of the internal structure after eight types of tempering. Crystal size and the recrystallization process were analyzed in relation to ion diffusion at various temperatures, and the ion activation energy was found to be E_{Cs} = 95 kcal/mol and E_{Sr} = 105 kcal/mol, which would indicate predominantly interstitial diffusion. The chief advantage of basalt is its recrystallization at high temperatures, which improves its physical and chemical properties for isotope fixation. If the decay heat does not exceed 600°C, Cs and Sr diffusion coefficients will not exceed 10^{-15} cm^2/sec, which is suitable for safe disposal of radioactive wastes. (ATD)

26553 THE TREATMENT OF RADIOACTIVE WASTE AT THE SOUTH AFRICAN NATIONAL NUCLEAR RESEARCH CENTER, PELINDABA. Barbour, R. A. (National Nuclear Research Center, Pelindaba, South Africa); Ayre, D. J. Vienna, International Atomic Energy Agency, 1965, Preprint No. SM-71/11, 22p. (CONF-651202-9). ORAU.

From Symposium on Practices in the Treatment of Low and Intermediate Level Radioactive Waste, Vienna.

The philosophy and the design of low- and intermediate-level radioactive waste facilities now under construction

at the National Nuclear Research Centre, Pelindaba, South Africa, are outlined. At Pelindaba, research and development covering the field of nuclear energy and allied sciences is centered around an ORR-type reactor (light water cooled and moderated) designed for ultimate operation at 20 Mw. Liquid wastes are discharged into a small river-dam complex with a high water utilization factor. The maximum allowable concentration for unidentified contamination in the mixed waste prior to discharge is 4×10^{-8} μC/ml. A high degree of liquid waste segregation is achieved at the source before it is drained to a central waste treatment facility. Intermediate level waste of low volume (45 m^3 per month) and high salinity is treated by a batch chemical blending or precipitation process followed by evaporation and mixed-bed ion exchange. Low-level waste (5–10 m^3 per day), contaminated in excess of 10^{-5} μC/ml, is treated by an identical but separate process. It is expected that decontamination factors in the order of 10^4–10^6 will be achieved by this combination of treatments. Concentrates from the evaporators are collected in a central dump tank from which they are transferred to a batch solidification facility, utilizing a premixed blend of cement and exfoliated vermiculite. The solidified concentrate will be permanently buried on site in a structure designed to prevent penetration by underground water. The volume of low-level solid waste is reduced in a fully contained pneumatic baling press prior to permanent burial on site. (auth)

26554 LOW LEVEL SLUDGE CONCENTRATION BY SOLAR EVAPORATION. Bonhote, P. A.; Hespe, E. D. (Australian Atomic Energy Commission, Lucas Heights, New South Wales). Vienna, International Atomic Energy Agency, 1965, Preprint No. SM-71/5, 11p. (CONF-651202–12). ORAU.

From Symposium on Practices in the Treatment of Low and Intermediate Level Radioactive Waste, Vienna.

The pre-disposal treatment of the sludges produced by the flocculation techniques used to decontaminate low-activity-level effluent streams presents problems in waste management. One solution found at the Australian Atomic Energy Commission's Research Establishment, Lucas Heights, is described. Details are given of the magnitude of the problem, the consideration given to methods used by other workers, the climatic conditions at Lucas Heights, and the reasons for investigating the possibility of using solar energy to achieve volume reduction of the sludge. The initial investigations and the resultant conclusions and plant design are described. Early operational results are given and initial operating costs reported. It is concluded that, where conditions are similar to or more favorable than those at Lucas Heights, solar evaporation is a safe and economical method of sludge concentration. It is suggested that in suitable locations the method could be combined with earth percolation. (auth)

26555 FILTRATION AND ION EXCHANGE PLANTS IN USE AT A.E.R.E., HARWELL. Burns, R. H.; Clarke, J. H.; Wright, T. D. (Atomic Energy Research Establishment, Harwell, Eng.). Vienna, International Atomic Energy Agency, 1965, Preprint No. SM-71/15, 41p. (CONF-651202–13). ORAU.

From Symposium on Practices in the Treatment of Low and Intermediate Level Radioactive Waste, Vienna.

The plants used for the filtration and subsequent ion-exchange decontamination of low- and medium-level effluent are described. Details are given of plant operation at 2.3 m^3/hr together with the decontamination factors achieved and the volumes of waste produced. It is shown that the filtration system produced a waste of 0.2% of the volume filtered. This low figure is attributed to the efficiency of the simple system used for dewatering the backwash liquors. Results for decontamination by filtration indicate that a large proportion of α activity can be removed at this stage. Although removal of βγ activity is lower and more variable, it is shown that it can be sufficient to necessitate shielding of the dewatering section of the plant. The details given for the ion-exchange plant include the efficiency of removal of both inactive and active ions. These show that the plant produces a reasonable quality demineralized water (circa 15 μmhos/cm) and gives average decontamination factors of 1000 for α and 1250 for β activities. It is shown that, by using a split regeneration technique, the waste from the plant can be kept down to 1.9% of the volume treated, making a total of only 2.1% for the combined treatment. Some anomalies found in the behavior of the plant are discussed and suggestions are made for reducing the waste still further. (auth)

26556 PRESENT PRACTICES IN THE TREATMENT OF LIQUID WASTES AT A.E.R.E., HARWELL. Burns, R. H.; Clarke, J. H.; Wright, T. D.; Myatt, J. H. (Atomic Energy Research Establishment, Harwell, Eng.). Vienna, International Atomic Energy Agency, 1965, Preprint No. SM-71/58, 21p. (CONF-651202–14). ORAU.

From Symposium on Practices in the Treatment of Low and Intermediate Level Radioactive Waste, Vienna.

The present practices in chemical treatment methods at A.E.R.E., Harwell, are described. These are a calcium-iron-phosphate precipitation at a pH of 11.5 and a calcium-phosphate-copper ferrocyanide precipitation at a pH of 10.0. Both are shown to be effective whether used in settlement tanks or in a sludge blanket precipitator, giving decontamination factors of up to 20. Reference is made to the use of crude vermiculite in the sodium form as a second stage after chemical precipitation, the over-all treatment giving a decontamination factor of 500. A new plant was recently commissioned with facilities available for two-stage batch chemical treatment, continuous chemical treatment in a sludge blanket precipitator, evaporation, and ion exchange using natural materials. Flow rates of up to 2.3 m^3/hour are possible depending on the processes used. Early experiences with all the processes are described. Particular reference is made to the use of a basket centrifuge for the ion-exchange stage using vermiculite as the ion exchanger. Sludges produced in the chemical treatment processes are settled in specially designed columns and the thickened material is either absorbed onto exfoliated vermiculite or frozen, thawed, and centrifuged depending on the activity level. Details are given of the new freezing plant, which will be commissioned this year and which is designed to handle up to 7 m^3/day. Finally, reference is made to the proposed sludge insolubilization plant. (auth)

26557 THE TECHNIQUE OF CEMENTING LIQUID, SLUDGE AND SOLID RADIOACTIVE WASTES. Butt, Yu. M.; Timashev, V. V.; Kutsenko, L. A.; Danilova, S. G. (State Committee on the Utilization of Atomic Energy, Moscow). Vienna, International Atomic Energy Agency, 1965, Preprint No. SM-71/39, 19p. (In Russian). (CONF-651202–15). ORAU.

From Symposium on Practices in the Treatment of Low and Intermediate Level Radioactive Waste, Vienna.

It is shown that the following materials can be reliably fixed in cement: precipitates consisting of iron hydroxide, aluminum hydroxide, managanese hydroxide, solid sulfate-silicate, ashes obtained from the burning of rags, paper, and wood, and a whole range of other materials. Operating conditions and procedures were worked out for cementing these wastes. Experimental data are given on the operation of a semi-industrial cementing installation. Other types of cementing process are discussed (two- and three-stage, etc.). The consumption of cement varies from 20 to 70%, depending on the composition of the waste. Different isotopes do not have the same stability of fixing in cement; Nb and Ru are fixed better than Sr and Cs. An analysis of cement properties such as durability, atmospheric stability, corrosion stability, solubility in water, frost stability, etc., shows that in many cases the indices characterizing these properties satisfy the requirements of reliable fixing. Radioactive cement blocks can be protected from the influence of ground waters by a special coating. (auth)

26558 THE INCINERATION OF RADIOACTIVE WASTES. Efimov, A. N.; Kontarovich, B. V.; Finyagin, A. P.; Shakhov, E. Kh. (State Committee on the Utilization of Atomic Energy, Moscow). Vienna, International Atomic Energy

Agency, 1965, Preprint No. SM-71/31, 20p. (In Russian). (CONF-651202-18). ORAU.

From Symposium on Practices in the Treatment of Low and Intermediate Level Radioactive Waste, Vienna.

With incineration of radioactive wastes it is possible to reduce the radioactive substances to ash and discharge the gaseous combustion products into the atmosphere after appropriate purification. Important points to be considered include the necessity of carrying out the incineration process in a rational manner, so as to ensure the most complete chemical and mechanical combustion, and the degree of ash removal and fixation of the radioactive components in the ash of the burnt material. The relation between the proportion of excess air in the combustion chamber during the period of intense combustion, the frequency with which the furnace is charged with the combustible material, and the thermal preparation of the fuel is shown. From these relations it appears that an increase in the chemical combustion factor can be achieved by reducing the interval between successive charging operations and by ensuring appropriate thermal conditions for preparation of the combustible material. It is shown that the combustion zone depends closely on the excess air coefficient. The fuel in the flux burns most intensely for an excess air coefficient of the order of 1.2–1.4. The principle of incinerating solid radioactive wastes in combination with a system of gas purification already used in experiments guarantees effective burning of wastes in a layer, giving ashes suitable for cementing and gaseous products free from radioactive aerosols. The reduction in waste volume is by a factor of about 100. (auth)

26559 THE DEGREE OF TREATMENT REQUIRED FOR LOW AND INTERMEDIATE LEVEL RADIOACTIVE WASTES FOR THE PREVENTION OF HAZARDOUS POLLUTION OF THE ENVIRONMENT. Kenny, A. W. (World Health Organization, Geneva). Vienna, International Atomic Energy Agency, 1965, Preprint No. SM-71/64, 15p. (CONF-651202-24). ORAU.

From Symposium on Practices in the Treatment of Low and Intermediate Level Radioactive Waste, Vienna.

The recommendations of the International Commission on Radiological Protection are taken as a basis for a general discussion of permissible levels for disposal of liquid and solid radioactive wastes to the environment. For the relatively small number of major radioactive disposals an experimental approach based on measurement of environmental pollution resulting from preliminary disposals at lower levels than those ultimately envisaged is recommended, firm levels being ultimately set in the light of calculated values of irradiation of the public. For smaller disposals where so elaborate an approach cannot be justified, permissible levels can be calculated from broad general considerations of the dispersal of the waste and the habits of the public. Tentative conservative levels are suggested for the disposal of liquid radioactive waste to sewers and rivers and for disposal of solid radioactive waste by tipping. The broad discussion of these methods of disposal, of disposal of liquid radioactive wastes to ground, and of incineration of solid radioactive wastes gives some guidance on how these levels may be relaxed in appropriate less restrictive conditions. Conversely, where the radioactive content of waste may ultimately appear in articles handled by the public, as when radioactive waste is salvaged, a more restrictive approach is considered essential. It is emphazised that the strict approach to radioactive health hazards and the painstaking evaluation of irradiation of the public constitute a degree of control not remotely approached with other industrial hazards; and that our knowledge of the effects of ionizing radiation, limited though it may be, enables us to assess the hazards with an accuracy not generally attainable in other fields. (auth)

26560 THE TREATMENT OF LOW AND INTERMEDIATE LEVEL LIQUID RADIOACTIVE WASTES AT THE KARLSRUHE NUCLEAR RESEARCH CENTER. Krause, H.; Nentwich, O. (Gesellschaft fuer Kernforschung mbH, Karlsruhe, Ger.). Vienna, International Atomic Energy Agency, 1965, Preprint No. SM-71/47, 37p. (CONF-651202-25). ORAU.

From Symposium on Practices in the Treatment of Low and Intermediate Level Radioactive Waste, Vienna.

The Nuclear Research Centre at Karlsruhe at present has a semi-technical plant for the decontamination of radioactive waste water. It comprises a batch-operated precipitating plant with a throughput of some 25 m^3 per day as well as an ion-exchange device consisting of six columns with a throughput of 3 m^3 per hour. In addition, there is a vapor compression evaporator of 1.3 m^3/hr capacity and a film evaporator of a capacity of 150 l/hr. The radioactive waste water accumulated at the institutes, operations divisions, and reactors is collected in vessels on the spot and, after having been checked for activity, is transported by tank truck. At present, about 30 m^3 of waste of activity concentrations between 10^{-6} and 10^{-2} C/m^3 are collected per day. In addition, about 2 m^3 of medium-level waste water are collected in bottles in the laboratories each month; their average activity ranges from 10^{-1} to 10^{-2} C/m^3. The waste water having activity concentrations < 10^{-4} C/m^3 as a rule is treated by chemical precipitation. Ion exchange is provided for water having a very low salt content, e.g., from the reactor cycles. Occasionally, water insufficiently decontaminated by chemical precipitation is treated a second time by ion exchange. In the film evaporator, all the regenerating water of the ion exchangers as well as the waste water collected in bottles at the laboratories is evaporated. The concentrates having a salt content of 35–50% are mixed with cement by stirring in a volume ratio of 1:1. The water coming from the waste water collecting stations having activity concentrations >10^{-4} C/m^3 are mostly concentrated in the vapor compression evaporator down to a salt content of 15–20%. The concentrates are stirred into hot bitumen. For chemical precipitation a method using iron hydroxide/potassium phosphate is frequently employed. If there are fission products present, this step is preceded as a rule by a nickel ferrocyanide precipitation. The decontamination factors attained by simple precipitation are between 2 and 30; by combined precipitation they are several hundred. In the precipitation of 100 m^3 of waste water 0.7–1 m^3 of filter residues is produced. In the vapor compression evaporator decontamination factors of 10^5 are attained. The energy requirements for the evaporation of 1 m^3 of water are 35 kg of additional steam, 40 kw of electric energy, and 1 m^3 of cooling water. The pilot plant available at present will not be able to handle the amount of radioactive waste likely to accumulate in the future. For this reason, a new plant is being designed which will contain, among other installations, two vapor compression evaporators with capacities of 4.5 m^3/hr each and a bitumen plant for fixing the concentrates. (auth)

26561 THE DECONTAMINATION OF LOW-LEVEL RADIOACTIVE WASTE WATER AT RISOE—THE DANISH ATOMIC ENERGY COMMISSION RESEARCH ESTABLISHMENT. Larsen, I. (Forsogsanlaeg, Risoe, Denmark). Vienna, International Atomic Energy Agency, 1965, Preprint No. SM-71/28, 17p. (CONF-651202-28). ORAU.

From Symposium on Practices in the Treatment of Low and Intermediate Level Radioactive Waste, Vienna.

The evaporation plant for treatment of low-level radioactive waste water described at the Monaco Conference in 1959 has now been in operation for more than six years. Details of several minor alterations and improvements are described in connection with a discussion of results and operation experiences. The main evaporator, which is of the vapor-compression forced-circulation type, remains unchanged except for minor improvements. The final evaporator described at the Monaco Conference gave such operational difficulties that it proved necessary to replace it by another type of evaporator. This is steam-heated with forced circulation and produces a sludge with 70 to 80% solids. It has now been in operation for more than two years. Details of construction and operation are given. The centrifuge originally installed in the plant to clean the feed to the main evaporator was only in use during

the first year of operation. It was replaced by a coarse-sand filter, intended only for the purpose of removing impediments that might clog valves, etc. Costs of installation and operation are discussed. (auth)

26562 TREATMENT OF COMBUSTIBLE SOLID LOW-LEVEL RADIOACTIVE WASTES AT RISOE—THE DANISH ATOMIC ENERGY COMMISSION RESEARCH ESTABLISHMENT. Larsen, I. (Forsogsanlaeg, Risoe, Denmark). Vienna, International Atomic Energy Agency, 1965, Preprint No. SM-71/50, 12p. (CONF-651202-29). ORAU.

From Symposium on Practices in the Treatment of Low and Intermediate Level Radioactive Waste, Vienna.

After several years of preliminary experiments and planning, a plant was installed at Risö during 1964 for the destruction of combustible, solid, low-level radioactive wastes by boiling the wastes with sulfuric acid. The combustible wastes are fed by means of a glove box into a quartz vessel half filled with sulfuric acid. The contents are heated by electricity and the reaction starts at 250°C. The resultant mixture of CO_2, SO_2, and H_2O travels to a sulfuric acid production tower, where the sulfuric acid is recovered and returned to the quartz vessel. The heat supply is regulated to give a constant flow of gas. The inorganic residue, containing most of the original radioactivity, remains in the quartz vessel. This is emptied every third month. The sludge is pumped to the evaporator for radioactive waste water. Plant capacity is restricted by the volume of the quartz vessel which takes up to 20 kg of waste per day. Some operational difficulties have been encountered, but the worst have now been overcome. Details of the plant and results from the first year of operation are given. (auth)

26563 THE USE OF ELECTRODIALYSIS WITH ION-EXCHANGE MEMBRANES FOR DESALTING AND PURIFYING LOW-LEVEL WASTE WATERS. Rauzen, F. V.; Dudnik, S.; Gutin, E. (State Committee on the Utilization of Atomic Energy, Moscow). Vienna, International Atomic Energy Agency, 1965, Preprint No. SM-71/29, 13p. (In Russian). (CONF-651202-34). ORAU.

From Symposium on Practices in the Treatment of Low and Intermediate Level Radioactive Waste, Vienna.

Studies showed that effective and economical purification of solutions from radioisotopes can be carried out by one of three methods of electrodialysis with ion-exchange membranes, according to the salinity of the solutions. Low-salinity solutions (50–100 mg/l) can be cleansed of radioisotopes to MPC level by filtering through a mixture of ion exchangers positioned between the membranes in the desalting chambers of an electrodialyzer connected to a source of direct current. In this method it is unnecessary periodically to regenerate the ion-exchangers; the ions absorbed from the solution constantly migrate into the adjacent chambers. Water purified to MPC level and almost the same volume of solution contaminated by impurities is obtained. The latter is processed by the second electrodialysis method. Radioactive solutions containing 1–5 g/l of salts, which cannot be economically purified to MPC level by desalting on ion exchangers, must be processed in multichamber electrodialyzers to reduce the content of salts to 0.1–0.5 g/l. These solutions can then be purified by normal ion exchange or by the first method of electrodialysis. It is shown that owing to electro-osmosis the concentration of the salt solution cannot exceed 1N. Radioactive solutions containing more than 5 g/l of salts should be partially desalted (to 1–5 g/l) between two electrodes separated by like membranes. In the electrode chambers acid and alkali are formed, and these must be used for production after being strengthened by circulation through suitable chambers. The combination of the three methods will purify any solution of radioisotopes to MPC level and result in a small volume of concentrate that can be buried. (auth)

26564 SOLIDIFICATION OF RADIOACTIVE SLUDGE USING BITUMEN. Rodier, J.; Alles, M.; Auchapt, P.; Lefillatre, G. (CEA, Marcoule, France). Vienna, International Atomic Energy Agency, 1965, Preprint No. SM-71/52, 17p. (In French). (CONF-651202-36). ORAU.

From Symposium on Practices in the Treatment of Low and Intermediate Level Radioactive Waste, Vienna.

At the Marcoule waste treatment plant chemical treatment by coprecipitation of radioactive aqueous effluent with a specific activity less than 25 C/m³ gives rise to radioactive mineral sludge with a high moisture content (50–80%). This sludge is a suspension of colloidal micelles or salt crystals onto which the radioelements are adsorbed. The idea of blocking the radioelements by means of a binding agent and of converting an aqueous suspension directly into a homogeneous solid inert with respect to soil, sea water, and other storage media led to the coating of radioactive sludge with bitumen. A process for coating sludge with bitumen consists in pouring the hot bitumen into the sludge to which a surface-active agent has been added. The resulting unstable emulsion is broken down immediately and almost all the water contained in the sludge escapes by exuding from the mastic formed. The small amount of residual water is eliminated by vaporization when the coated material is heated before being placed in containers. Diffusion studies carried out in the laboratory with coated radioactive sludge immersed in water of varying pH and in sea water showed that the dispersion of radioelements in these media is slight. Following the satisfactory results of laboratory and pre-pilot tests an installation for coating sludge with bitumen was built at the Marcoule waste treatment plant. This installation is capable of coating in a continuous operation 600 liters per hour of radioactive sludge. (auth)

26565 PACKAGING OF RADIOACTIVE WASTE USING INDUSTRIAL METHODS. STUDY OF DEVELOPMENTS IN PRODUCTION AND COSTS. Rodier, J.; Cohendy, G.; Boutot, P.; Cochet, J. (CEA, Marcoule, France). Vienna, International Atomic Energy Agency, 1965, Preprint No. SM-71/53, 20p. (In French). (CONF-651202-37). ORAU.

From Symposium on Practices in the Treatment of Low and Intermediate Level Radioactive Waste, Vienna.

The segregation of different types of radioactive waste was taken as the basis for packaging. As practiced at the production sites, segregation is carried out by type of radioactive element, type of radioactivity, and nature of the waste. Aside from the question of radioactivity, three categories of waste emerge: combustible waste, noncombustible but compressible waste, noncombustible and noncompressible waste. Waste belonging to the first category is disposed of by incineration. Packaging of the radioactive products belonging to the other categories is carried out by encasing them in concrete, which serves as a radiation shield and acts as a barrier preventing the spread of contamination. Metal drums with a capacity of 200 liters were chosen as the basic packaging unit. Compressible waste is collected in 100-liter drums and compacted by a 60-ton press. A 200-liter drum holds three to four 100-liter drums. Non-compressible waste is placed in expanded metal cages of 125 liters capacity fixed centrally in 200-liter drums; which act as molds. The concrete casing is formed by filling the space between the walls of the drums and the waste material with gravel and injecting vibrated grout. More than 95% of the solid radioactive waste disposed of at the Plutonium Production Centre has been packaged by this system. At the packaging installation 80 drums can be prepared in this way in 80 man/hours. The average cost for combustible and noncombustible waste is about 400 francs per cubic meter, including the cost of collection, segregation, storage at the Centre and all depreciation charges. (auth)

26566 INDUSTRIAL INCINERATION OF RADIOACTIVE WASTE: TECHNIQUES AND FINANCES. Rodier, J.; Lefillatre, G. (CEA, Marcoule, France). Vienna, International Atomic Energy Agency, 1965, Preprint No. SM-71/54, 24p. (In French). (CONF-651202-38). ORAU.

From Symposium on Practices in the Treatment of Low and Intermediate Level Radioactive Waste, Vienna.

A plant that eliminates a certain number of difficulties in incineration of radioactive wastes is discussed. Preliminary sorting of waste was found to be indispensable for efficient functioning of the plant; this avoids the intro-

duction of pieces of metal that might foul the screens or of bottles of solvents or of fine dusts that might cause an explosion. Combustion with propane is carried out in a refractory brick furnace, beyond which is situated a post-combustion expansion chamber. After cooling by passing through two heat exchangers and after having undergone three stages of filtration, the gases are released into the atmosphere following passage through a neutralization tower. The system of ash removal is designed to enable large ash and clinker to be removed from the front face of the ash pit, or ash in the form of slimes to be removed by gravity for subsequent treatment by coating with bitumen. The incinerating capacity of the plant is 100 kg solid waste per hour. Tests have shown that the volume reduction ratio obtained for dry ash is 1.2% and the weight reduction ratio 4%. The main hazards in routine operation are corrosion and burning of the filtering devices. From the point of view of radiation safety, the method of dry scrubbing of gases gives excellent results and the combination of post-combustion, prefiltration, complete filtration, and scrubbing of the gases stops 99.9% of the radioactive products. The major disadvantage of incineration is its high cost, which is due to the heavy investment outlay and the costs of sorting. However, certain categories of wastes in themselves justify incineration as a method of treatment. These include wood, concrete, oils, and heavy solvents. (auth)

26567 THE CIES PILOT PLANT FOR TREATING RADIOACTIVE LIQUID WASTES FROM THE PROCESSING OF IRRADIATED FUEL ELEMENTS AT THE JUNTA DE ENERGIA NUCLEAR (SPAIN). de Lora Soria, F.; Lopez Perez, B. (Junta de Energia Nuclear, Madrid). Vienna, International Atomic Energy Agency, 1965, Preprint No. SM-71/65, 10p. (In Spanish). (CONF-651202-42). ORAU.

From Symposium on Practices in the Treatment of Low and Intermediate Level Radioactive Waste, Vienna.

The pilot plant for processing liquid radioactive wastes under construction at the Junta de Energía Nuclear, Madrid, Spain, in conjunction with a pilot plant for the processing of irradiated fuel elements, is described. Low-activity residues will be decontaminated by a coagulation-refinement-ion exchange system. Residues of medium activity will be evaporated and the concentrates fixed in asphalt for final storage. High-activity wastes will be temporarily stored. The capacity of the plant for low-activity wastes will be 3000 l/day and for those of intermediate activity 700 l/day. It is expected that the low-activity section of the plant will begin operating in April 1966. (auth)

26568 THE SOLIDIFICATION OF SLUDGES FROM COAGULATION. Spitsyn, V. I.; Volkova, A. V.; Balukova, V. D. (State Committee on the Utilization of Atomic Energy, Moscow). Vienna, International Atomic Energy Agency, 1965, Preprint No. SM-71/38, 7p. (In Russian). (CONF-651202-43). ORAU.

From Symposium on Practices in the Treatment of Low and Intermediate Level Radioactive Waste, Vienna.

Processes for solidifying radioactive wastes of medium activity are discussed. Special consideration is given to the sludges obtained after purification of low-level waste waters by coagulation. The sludges contain precipitates of hydroxides and phosphates and organic cleansing reagents. The sludges are concentrated by freezing and evaporating. A ceramic mass is prepared from the concentrates; it is sintered into ceramic blocks by alumina-phosphate binding. The chemical stability is improved by introducing into the mass heat-resistant clay or other materials containing alumina. After solidification in air the ceramic mass undergoes thermal treatment at a temperature of about 500°. The method of solidifying in ceramic form is quite reliable. (auth)

26569 THE TREATMENT OF LOW-LEVEL SOLID WASTES BY COMPRESSION AND BALING. Wasling, W.; Griffin, F. E. (Atomic Weapons Research Establishment, Aldermaston, Eng.). Vienna, International Atomic Energy Agency, 1965, Preprint No. SM-71/16, 20p. (CONF-651202-46). ORAU.

From Symposium on Practices in the Treatment of Low and Intermediate Level Radioactive Waste, Vienna.

The design and operation of a process unit for the handling, sorting, and compression of low-level active solid wastes are described. The unit is divided into two separate compartments: one is a baling unit for sorting and compressing low-level combustible and non-combustible wastes into bales for either incineration or storage and land burial; the other is for the sorting and compressing of radioactive solid wastes direct into sea disposal coffins. The unit is designed to handle wastes contaminated with particulate alpha activity and is operated by a glove box technique with high velocity air extract and high efficiency filtration. Compression of the waste is obtained by means of compressed-air-operated rams with maximum loads of $3\frac{1}{2}$ tons and 10 tons respectively for the baling and the direct compaction processes. The working capacity of the baling unit on average mixed wastes from laboratories and workshops is approximately 100 lb/hr, and the volume reduction achieved is about $2\frac{1}{2}$ to 1. The working capacity of the direct compacting unit is approximately 135 lb/hr and produces a volume reduction of between 3 and 5 to 1 depending on the nature of the waste. Operation safeguards are built into the process unit in the form of electromechanical interlocks, fire-fighting equipment, etc. (auth)

26570 INCINERATION OF LOW-LEVEL RADIOACTIVE SOLID WASTES AND GAS CLEANING—SOME OPERATIONAL EXPERIENCES. Amalraj, R. V.; Khan, A. A.; Thomas, K. T. (Atomic Energy Establishment, Trombay, India). Vienna, International Atomic Energy Agency, 1965, Preprint No. SM-71/18, 21p. (CONF-651202-5). ORAU.

From Symposium on Practices in the Treatment of Low and Intermediate Level Radioactive Waste, Vienna.

The Waste Treatment Division of the Atomic Energy Establishment Trombay faced the problem of disposal of solid wastes accumulated from various production and research facilities. A 25 Kg/hr single chamber refractory furnace of monolithic construction with an entirely dry gas cleaning system was designed, installed, and successfully operated for several months. The report provides the performance data on operations carried out in this plant during the incineration of a typical alpha-contaminated waste containing highly corrosive chemicals. The performance characteristics of several filter fabrics were evaluated, and the results obtained in cooling and cleaning the flue gases revealed that a completely dry gas cleaning system is technically and economically feasible. Based on the above experience, a more advanced type of multi-chamber incinerator was set up to attain higher combustion efficiency, and details of the equipment and its performance are presented. The operational health physics aspects of the plants are also discussed. (auth)

26571 TREATMENT OF INTERMEDIATE- AND LOW-LEVEL RADIOACTIVE WASTES AT NRTS. Amberson, C. B.; Rohde, K. L. (Phillips Petroleum Corp., Idaho Falls, Idaho). Vienna, International Atomic Energy Agency, 1965, Preprint No. SM-71/42, 26p. (CONF-651202-6). ORAU.

From Symposium on Practices in the Treatment of Low and Intermediate Level Radioactive Waste, Vienna.

Chemical solutions are concentrated by evaporation and stored in stainless steel tanks for eventual calcination. The evaporator overheads are sufficiently low in radioactivity to be discharged to ground when combined with non-radioactive plant waste water. Approximately 1,500,000 gallons of chemical solution type wastes are treated annually by this technique. Another 1,000,000 gallons of contaminated water from the fuel storage basin are treated annually in mineral-bed ion exchangers. The contaminated mineral beds are buried with other solid wastes, and the liquid effluent is returned to the ground water table. The maximum amount of radioisotopes released to the ground as a result of waste treatments is 0.22 C of beta emitters per million gallons, of which about 90% is tritium. About 10,000 gallons of organic waste are treated annually by steam stripping, with the distillate being burned and the resultant gases being discharged to the atmosphere. The concentration of

radioisotopes in the gases at the top of the 250-ft stack is about 10^{-9} μC/cc. Operating experience and cost data are presented. (auth)

26572 ELIMINATION OF RUTHENIUM FROM EFFLUENTS BY ANIONIC CO-PRECIPITATION WITH LEAD PERIODATE IN LIQUIDS OF INTERMEDIATE ACTIVITY. Auchapt, J. (CEA, Marcoule, France). Vienna, International Atomic Energy Agency, 1965, Preprint No. SM-71/55, 7p. (In French). (CONF-651202-7). ORAU.

From Symposium on Practices in the Treatment of Low and Intermediate Level Radioactive Waste, Vienna.

A process is described for eliminating ruthenium from effluents occurring in irradiated fuel processing. The process is designed for a waste treatment plant using co-precipitation and is employed with effluents rich in ruthenium, resulting in particular from the scrubbing of spent solvent by sodium carbonate and the raffinate produced in the second uranium decontamination cycle. The method consists of forming in situ a lead periodate precipitate by the addition of 220 ppm of paraperiodate ($IO_6H_2Na_3$) in a slightly acid medium (pH ≤ 2) to the effluent which, if it contains reducing agents, must first be oxidized by means of a slight excess of potassium permanganate. The reagent is precipitated by an excess of lead at a pH of 5 (400 ppm of Pb^{2+} in nitrate form). This treatment must precede co-precipitation of the other radioisotopes. It makes possible the elimination of 50–90% of the ruthenium that escapes other forms of treatment, with an average elimination of 80%. The cost of the reagents is about 20 francs/m^3, while the total cost for the normal treatment of this type of effluent is 320 francs/m^3, of which reagents account for 32 francs. The process has proved completely satisfactory in trials with a pilot plant identical with the actual installation, and its full-scale application is expected shortly. (auth)

26573 CONVERSION OF ^{106}Ru AND ^{137}Cs TO THE GASEOUS PHASE IN THERMAL TREATMENT OF RADIOACTIVE WASTES. Baranaev, M. K.; Zimakov, P. V.; Vereskunov, V. G.; Zakharova, K. P.; Krylova, N. V.; Kulichenko, V. V. (Inst. of Physical Chemistry, Moscow). Vienna, International Atomic Energy Agency, 1965, Preprint No. SM-71/34, 22p. (In Russian). (CONF-651202-8). ORAU.

From Symposium on Practices in the Treatment of Low and Intermediate Level Radioactive Waste, Vienna.

It is shown that the volatilization of ruthenium and cesium depends on the chemical composition of the products being treated and on the conditions under which the process is carried out. Volatilization of ruthenium is increased if the mixture contains an oxidant (e.g., sodium nitrate) or chromium and manganese oxides, which act as catalyzers for oxidation from ruthenium dioxide to tetroxide. In the presence of components which easily absorb ruthenium tetroxide (e.g., iron oxide), the conversion of ruthenium-106 to the gaseous phase is appreciably reduced. The volatilization of cesium is accompanied by thermal dissociation of its salts with formation of metallic cesium or cesium oxide at temperatures exceeding 500°C. The presence of aluminum and silicon oxides in the mixture leads to cesium volatility through chemical absorption on the surface of the aluminum oxide or to the formation of cesium silicates, which are stable up to 1100°C. The presence of sodium oxide in the mixture leads to increased volatilization of cesium as a result of its being liberated from the compounds mentioned. In the melt, neither cesium nor ruthenium give hard silicates, so that these are practically absent from thin layers of melt. On the basis of the work performed, it was possible to determine how the process should be carried out in order that ruthenium and cesium may be localized in the final product. For localization of ruthenium in the mixture, the addition of reducing agents is recommended; those added at the calcination stage are different from those added at the melting stage. For localization of cesium at the calcination stage the necessary amounts of aluminum oxide or silicon dioxide are added. The conversion of cesium to the gaseous phase at the melting stage can be reduced by decreasing the surface of the melt, but conversion of cesium to the gaseous phase can be completely prevented only by placing a layer of silicate on the surface of the melt. (auth)

26574 THE TREATMENT OF LOW-LEVEL SOLID RADIOACTIVE WASTE AT THE KARLSRUHE NUCLEAR RESEARCH CENTER. Krause, H.; Stollberg, H. (Gesellschaft fuer Kernforschung mbH, Karlsruhe, Ger.). Vienna, International Atomic Energy Agency, 1965, Preprint No. SM-71/48, 20p. (CONF-651202-26). ORAU.

From Symposium on Practices in the Treatment of Low and Intermediate Level Radioactive Waste, Vienna.

An improvised temporary pilot plant for the treatment of low-level solid radioactive waste at the Nuclear Research Center, Karlsruhe, consists of a sorting box, a filter crushing plant, an incineration plant, and a baling press. The operation of this pilot plant is to provide experience and technical data for the later design of an operating plant. In the sorting box the waste is sorted into flammable and nonflammable components. The incineration furnace has the shape of a cylinder, the bottom part of which is a strongly tapered cone. The waste is fed in at the top after having been transported through a sliding lock; then it drops on a revolving grate closing the furnace at the bottom. Electrically preheated air is fed in the bottom part of the furnace for direct combustion and is introduced above the material for afterburning. The combustion gases pass through a dust separator, are cooled to 120°C in a tubular cooler, are prefiltered in a bag filter of fiberglass, and then are filtered in high efficiency superfine filters. Behind the superfine filter there is a blower sucking off the combustion gases and maintaining the furnace at a negative pressure of 80 mm of mercury. The furnace will burn about 200 l of waste per hour. Compressible solid waste not suited for burning is concentrated in volume in a hydraulic baling press. (B.L.M.)

26575 METHODS OF REMOVING RADIOACTIVE ELEMENTS (URANIUM, RADIUM, POLONIUM, IONIUM) FROM MINE WATERS AND RETURN WATERS. Laskorin, B. N.; Bakhurov, V. G.; Lutsenko, I. K.; Metalnikov, S. S.; Tyutrina, A. P.; Terentev, A. S.; Dolgikh, P. F.; Efimov, A. A.; Vorobeva, Z. A. (State Committee on the Utilization of Atomic Energy, Moscow). Vienna, International Atomic Energy Agency, 1965, Preprint No. SM-71/28, 22p. (In Russian). (CONF-651202-30). ORAU.

From Symposium on Practices in the Treatment of Low and Intermediate Level Radioactive Waste, Vienna.

It is shown that it is necessary to cleanse waste waters of radioisotopes before transferring them to an aqueous medium. Different ways of removing radioactive elements from mine waters to MPC level, with recovery of the uranium for subsequent use were considered. To remove uranium from mine waters use was made of the ion exchange resins and of coprecipitation methods. Removal of radium, polonium, and ^{230}Th from mine waters was carried out with the aid of natural pyrolusite and activated sawdust. The capacity of the pyrolusite and activated sawdust was 6×10^{-9} C/g for Ra; 3.9×10^{-9} C/g for Po (up to breakthrough, i.e., 5×10^{-11} C/l). Ways of reducing the amount of waste water in tailing stores by reverse water supply and methods of removing radioactive substances from this water are reported. Installations for purifying mine waters and waste waters in tailing stores so as to allow safe disposal are described. Technical and economic data are given per cubic meter of waste solution. (auth)

26576 SOME RECENT IMPROVEMENTS IN THE LOW LEVEL LIQUID EFFLUENT TREATMENT PROCESS. Levi, H. W.; Melzer, H. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). Vienna, International Atomic Energy Agency, 1965, Preprint No. SM-71/7, 22p. (CONF-651202-31). ORAU.

From Symposium on Practices in the Treatment of Low and Intermediate Level Radioactive Waste, Vienna.

The low-level liquid effluent treatment process at the

Hahn-Meitner Institute is designed for discontinuous operation. The normal treatment is iron phosphate precipitation, sludge filtration, and base exchange with Filtrolit for Cs removal. Ion exchange with resins is used only if insufficient decontamination could be achieved. Sludge filtration is carried out with a pressurized filter containing ceramic filter elements. The limiting factor of the volume reduction is the addition of filter aid, which is unavoidable with this filtration technique. Base exchange with Filtrolit was recently adopted at the Hahn-Meitner Institute. Filtrolit is an inexpensive natural base exchanger containing several minerals including zeolites. It shows a distinct selectivity for Cs, has a reasonable volume capacity and can be used in columns with high flow rate. Since ion exchange resins are used only occasionally, tests were made to determine whether resins can be stored ready for use over a long period of time. Strongly acid cation exchangers in the H^+ and Na^+ form and strongly basic anion exchangers in the Cl^- form showed only a slight loss of capacity after a one-year period. Anion exchangers in the OH^- form and consequently mixed beds showed a considerable decrease of capacity. Usually the application of ion exchange resins can be restricted to cation exchanger. Some effort was made to optimize regeneration of cation exchange resins. Reasonable reduction of spent regenerant volume could be achieved by increasing the regenerant concentration with virtually no influence on capacity and decontamination efficiency. The volume of rinsing water that needs to be treated as radioactive equals roughly the regenerant volume. (auth)

26577 DISPOSAL OF LOW LEVEL COMBUSTIBLE SOLID WASTES BY INCINERATION. Silverman, L. (Harvard School of Public Health, Boston). Vienna, International Atomic Energy Agency, 1965, Preprint No. SM-71/25, 39p. (CONF-651202-40). ORAU.

From Symposium on Practices in the Treatment of Low and Intermediate Level Radioactive Waste, Vienna.

The general features of incinerators for radioactive wastes and their performance in several U. S. institutions and AEC laboratories are described. The composition of off gases and solids on several research studies is detailed with information on burning a variety of combustible wastes. These incinerators have proved satisfactory for disposal of paper and textile wastes, animal carcasses and litter, and various other organic materials. Volume reductions from 90 to 95% have been obtained in practice. A comparison of incinerators operating with and without auxiliary fuel such as gas or oil is given. The effects of various factors on gas cleaning requirements are shown. Data on various research investigations conducted at Harvard and elsewhere on effluent cleaning are presented. This includes (a) work by the U. S. Bureau of Mines on prototype institutional incinerators, (b) joint studies by the U. S. Bureau of Mines and Harvard, (c) Harvard studies, and (d) development of a 50-pound-per-hour incinerator and gas cleaning system at the U. S. Army Chemical Center. It can be concluded that at low (5 pounds per hour) burning rates with auxiliary fuel, it is possible to minimize loss of particulates in the effluent. With higher rates and self-firing, it will be necessary to provide some gas-cleaning device. If liquid waste disposal facilities are available, some scrubbing devices may be satisfactory followed by a high efficiency filter, if high levels of activity are present. If only dry wastes are to be handled, dry gas-cleaning devices such as electrostatic precipitators can be employed. High-efficiency filter temperature limits must be met by use of dilution air or spray cooling techniques. (auth)

26578 LOW LEVEL WASTE TREATMENT AT REACTOR CENTRUM NEDERLAND. Smeets, L.; Verkerk, B. (Reactor Centrum Nederland, Petten, Netherlands). Vienna, International Atomic Energy Agency, 1965, Preprint No. SM-71/10, 14p. (CONF-651202-41). ORAU.

From Symposium on Practices in the Treatment of Low and Intermediate Level Radioactive Waste, Vienna.

The waste treatment facilities on the site of RCN, Petten, were designed to serve a number of radiochemistry laboratories, where work on millicurie level was foreseen. They have been in operation now for about five years at increasing level, but still have large over-capacity for low level liquids. This will be taken up largely next year when an isotope production facility will come into use. In the low level liquid waste from this facility an amount of organic liquids will be present that may cause difficulties in treatment. Liquid wastes are first stored in a number of 50, 100, and 200 m^3 ponds, analyzed for total α and β activity, and if necessary treated in a flocculation plant, also equipped with sand filter and ion-exchange column. Sludges are concentrated by freezing and thawing. Final sludges contain about 25–30% solids. Effluents are again analyzed and disposed of in the North Sea through a 4 Km long vulcathene pipeline. Our license allows for discharge of 15 mC/day of unspecified activity including α-emitters at a maximum concentration of 2×10^{-4} μC/ml. Design data of the semi-continuous flocculation plant are given and operational experience on a few different types of wastes, including liquids mixed with laundry effluent, are presented. A short description is also given of the procedures for treatment of low level solids for which baling techniques are applied resulting in 5- to 10-fold volume reduction. Operational experience of the Government-RCN waste collecting service is also given. (auth)

26579 A METHOD OF REMOVING URANIUM FROM BATH WATER AND WATER USED FOR DEACTIVATION OF EQUIPMENT. Vorobeva, Z. A.; Bakhurov, V. G. (State Committee on the Utilization of Atomic Energy, Moscow). Vienna, International Atomic Energy Agency, 1965, Preprint No. SM-71/27, 6p. (In Russian). (CONF-651202-45). ORAU.

From Symposium on Practices in the Treatment of Low and Intermediate Level Radioactive Waste, Vienna.

Results of research on the removal of uranium from waste waters obtained from the washing of overalls, deactivation of equipment, floor washing, etc., are given. Water in which overalls were washed contains uranium, soap, trisodium phosphate, soda, and other detergents. The amount of dry precipitate contained is 5–7 g/l. Water from deactivation of equipment, floor washing, etc., is highly mineralized (amount of dry precipitate 50–100 g/l); the water contains uranium and Twitchell deactivation reagent in amounts of 20–40 g/l. It is shown that waste material from the timber industry—sawdust previously activated with phosphoric acid—can be used as sorbent. Purification to MPC is carried out in accordance with a fixed schedule. With one volume of sorbent 70–300 volumes of solution are purified. The capacity of the sorbent for uranium is 6–28 g/kg. In order to recover the uranium for practical use, recourse is to desorption or else the sorbent is burnt. This gives a uranium concentration factor of 2400. (auth)

26580 NEW SYSTEM FOR HANDLING SOLID WASTE AT THE SACLAY NUCLEAR STUDIES CENTER. Cerre, P.; Mestre, E. (CEN, Saclay, France). Vienna, International Atomic Energy Agency, 1965, Preprint No. SM-71/56, 17p. (In French). (CONF-651202-16). ORAU.

From Symposium on Practices in the Treatment of Low and Intermediate Level Radioactive Waste, Vienna.

Economic and technical aspects of a press for compacting solid waste, which has been in operation since the end of 1964, are considered in the present paper. Over the years more than 13,000 drums of waste (earth, rubble, and metal contaminated by fission products) had accumulated at Saclay. Emptying the drums involved a number of difficulties and meant that the empty drums had to be decontaminated, while the cost of sealing a drum and its contents in a concrete container was high (2115 francs/m^3). The drums together with the waste material were compacted in a steel mould, and the resulting compacted mass was transferred to a concrete container into which a cement grout was then pumped. The paper outlines the process and the safety arrangements, and gives a detailed description of the installation. With this process 5 to 20 220-liter drums can be placed in a container of 800 liters

capacity. The economics of the process also are discussed. (auth)

26581 TREATMENT OF LOW-ACTIVITY LIQUID WASTE BY CO-PRECIPITATION AT THE SACLAY NUCLEAR STUDIES CENTER. Cerre, P.; Mestre, E.; Bourdrez, J. (CEN, Saclay, France). Vienna, International Atomic Energy Agency, 1965, Preprint No. SM-71/57, 20p. (In French). (CONF-651202-17). ORAU.

From Symposium on Practices in the Treatment of Low and Intermediate Level Radioactive Waste, Vienna.

Ten year's experience of operating the low-activity liquid effluent treatment plant at Saclay has led to improvements and modifications of the treatment cycle. Certain aspects of flocculation and in particular techniques for solidifying sludge are considered. The increasing specific activity and volume of effluent requiring processing made it necessary to perfect the techniques employed, to provide greater protection and, above all, to complete the effluent treatment cycle by devising a means of handling the sludge resulting from the treatment itself. Apart from its increasing specific activity this sludge consists of 80% water. These two factors necessitate a reappraisal of the problem of handling and storing the concentrates, and the paper describes in detail modifications to the plant affecting principally (i) remote control of the valves, (ii) settling and filtration, (iii) solidification and final packaging of the sludge. The operating results are also analyzed to elucidate economic aspects of the problem. (auth)

26582 THE EVAPORATION PLANT OF THE INSTITUTE FOR RADIOCHEMISTRY AND OF THE RESEARCH REACTOR FRM MUNICH FOR TREATMENT OF LOW AND INTERMEDIATE LEVEL LIQUID RADIOACTIVE WASTES. Foeldes, P.; Staerk, H. (Technische Hochschule, Munich). Vienna, International Atomic Energy Agency, 1965, Preprint No. SM-71/6, 18p. (CONF-651202-20). ORAU.

From Symposium on Practices in the Treatment of Low and Intermediate Level Radioactive Waste, Vienna.

A two-stage evaporation plant for treatment of radioactive liquid wastes built on the grounds of the research reactor FRM Munich is described. The plant is so dimensioned that all low and intermediate level liquid wastes both from the reactor and from the Institute for Radiochemistry can be evaporated. The first stage of concentration is carried out with a forced-circulation evaporator that is electrically and steam heated. The evaporator is equipped with a cyclone separator and a compressor to transfer the vapor in super-heated steam. The second stage is a film evaporator with a stirring gear to get a high degree of concentration (50–70% solids in concentrate). For final storage the highly-concentrated intermediate level wastes will be fixed in bitumen. After completion of the plant designed and constructed by Pintsch-Bamag some technical investigations concerning capacity, heat transfer, and efficiency of the forced-circulation evaporator were carried out under various experimental conditions. The variation of the number of rotations, the influence of the encrustations, and variations of temperature and pressure differences were studied. Some experiments with intermediate level activities of ^{24}Na and ^{128}I were performed to determine the decontamination factor (D.F.) at various points of the evaporation system. The test indicated a D.F. of 10^6 between feed and condensate. Experiments to determine the relationship between the D.F. and the pH-conditions showed that in the region of pH 8–4.0 the D.F. values were between 10^5 and 10^6 with the D.F. decreasing rapidly at lower pH values. (B.L.M.)

26583 WASTE TREATMENT AT INSTITUTT FOR ATOMENERGI, KJELLER. Gaudernack, B.; Lundby, J. E. (Institutt for Atomenergi, Kjeller, Norway). Vienna, International Atomic Energy Agency, 1965, Preprint No. SM-71/22, 18p. (CONF-651202-21). ORAU.

From Symposium on Practices in the Treatment of Low and Intermediate Level Radioactive Waste, Vienna.

The disposition of radioactive wastes from the various sources at Kjeller, Norway are discussed. Some of the low activity liquid effluent is released directly to the river Nitelva after monitoring. The maximum release permitted at the present time is 0.5 curies (weighted) per 30 days. This will be extended to 2 curies (weighted) per 30 days after completion of a special effluent release line now under construction. The remaining low- and intermediate-level liquid wastes are treated in a waste treatment plant prior to release or storage. Separate beds of synthetic cation and anion exchange resins are used to purify the low-level wastes. By preceding the ion exchange step with a flocculation treatment (addition of alum and adjustment of pH to 6.5) the overall efficiency was considerably improved. When saturated, the ion exchange resins are regenerated by means of nitric acid and sodium hydroxide. The regenerant solutions are mixed, concentrated by evaporation, and solidified by addition of Portland cement. This same procedure is used for intermediate-level wastes from the reprocessing pilot plant and other laboratories. Some waste solutions, not suited for evaporation, are solidified directly. Solid wastes are collected and cast into concrete in drums or blocks. When possible, the volume is reduced by means of a hydraulic press. At present all solid waste (including solidified liquids) is stored on the site of the Institute. The final method of storage or disposal has not yet been decided. The experience obtained in operating the plant since 1962 is discussed. The cost of treating some of the waste types has been calculated. Since the amounts of liquid waste needing treatment are relatively small, a batch-wise operation of the plant has been satisfactory. (B.L.M.)

26584 DECONTAMINATION OF LIQUID WASTE FROM THE REGENERATION OF THE ION-EXCHANGE UNITS OF A HIGH-FLUX REACTOR. Iranzo, E. (Junta de Energia Nuclear, Madrid). Vienna, International Atomic Energy Agency, 1965, Preprint No. SM-71/17, 28p. (In Spanish). (CONF-651202-23). ORAU.

From Symposium on Practices in the Treatment of Low and Intermediate Level Radioactive Waste, Vienna.

During regeneration of the ion-exchange units utilized for the purification of water used in the cooling of the reactor core and in the pool in which the core is installed, liquid radioactive waste is formed, with activities of the order of 10^{-4} to 10^{-3} mc/l. The waste contains large amounts of salts in solution (2.5 to 4.0 g/l), and the majority of its radioactive elements are in anionic form. The present paper describes laboratory investigations and the results subsequently obtained on an industrial scale at the Reactor Centrum Nederland, Petten, in reducing the contamination of this waste to such an extent that it could be disposed of directly into the sea in accordance with the restrictive conditions imposed by the Dutch health authorities. The method employed was flocculation by the addition of barium chloride, ferric chloride, and sodium hydroxide. The role of each reagent was determined, and those Ba^{2+} and Fe^{3+} concentrations and pH values which achieve greatest decontamination, of the order of 98%, were established. Results are presented for the treatment of the decontaminated liquid waste with cationic and anionic ion-exchange resins with a view to establishing their efficiency in cases where additional decontamination is necessary. In view of the possibility that an accident involving the fuel elements of the high-flux reactor might lead to the contamination of the water in the primary cooling system or in the pool by a small amount of fission products, values are given for the decontamination which would be achieved by using this flocculation method in the treatment of the liquid waste formed during regeneration of the ion-exchange units used in purifying this water. (auth)

26585 UNDERGROUND STORAGE AND DISPOSAL OF RADIOACTIVE PRODUCTS. Billue, Gaines H. U. S. Patent 3,236,053. Feb. 22, 1966. Filed Oct. 9, 1959.

A method of safely storing radioactive material comprises the following steps: making a bore hole through alternating beds of salt and shale beneath the surface of the earth; leaching away portions of the salt beds to form a number of vertically spaced chambers above the bore hole and in communication with it; removing the salt wa-

ter from the chambers; mixing a solution of radioactive material to be stored with alkali to neutralize any acid present in the solution; and depositing the radioactive-alkali solution in at least one of the chambers. The bore is then sealed to prevent the escape of radioactive material from the bore hole. If any radioactive material refluxes due to thermal energy released, the material cannot escape. (B.L.M.)

GENERAL AND MISCELLANEOUS

26586 (BNL–954) NUCLEAR ENGINEERING DEPARTMENT ANNUAL REPORT, DECEMBER 31, 1965. (Brookhaven National Lab., Upton, N. Y.). Contract AT-30-2-GEN-16. 182p. Dep. mn. CFSTI $5.00 cy, $1.00 mn.

Research and development progress is reported in six sections. Separate abstracts were prepared for each section. (J.R.D.)

For abstracts of individual sections see: 24971, 25120, 25180, 25474, 26459, and 26533.

26587 (NP–15919) SEVENTH REPORT ON THE ACTIVITIES OF THE AGENCY. (European Nuclear Energy Agency, Paris (France)). Dec. 1965. 125p. Dep. mn.

Activities at the Eurochemic plant directed toward plant startup are summarized. Development and operation of the Halden and Dragon reactors are reported. Activities associated with the European Nuclear Energy Agency (ENEA) in the areas of scientific cooperation, regulation and control, and nuclear power are summarized. Information is included concerning organization of ENEA, reactor safety, agreement for collaboration on fruit irradiation, and decisions concerning liability associated with small quantities of nuclear materials. Information is also included on research reactors, critical assemblies, and power stations in ENEA member countries. (J.R.D.)

26588 (NP–15950) ANNUAL REPORT OF THE DEPARTMENT OF ATOMIC ENERGY, GOVERNMENT OF INDIA, 1965–66. (Department of Atomic Energy, Bombay (India)). 60p. Dep. mn.

Activities associated with planning for future nuclear power and operation of the present power program are summarized. Information is included concerning operation of the CIR and Zerlina reactors, research on nuclear physics and laser beams. Information is also included on health physics, chemical engineering, fuel processing and waste treatment, metallurgy, isotope research and production, radiochemistry, reactor engineering, biochemistry and food technology, radiobiology, physics research, cosmic research prospecting for minerals used in atomic energy, and atomic power development. Very few technical data are included. (J.R.D.)

26589 (SC-CR-66-2025) A STUDY OF IMPACT EFFECTS ON SPHERICAL SHELLS. Quarterly Progress Report No. 9, November 1, 1965–January 31, 1966. Stoneking, Charles E. (Sandia Corp., Albuquerque, N. Mex.). Contract AT(29-1)-789. 30p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

A study was made to investigate the structural integrity of hollow spheres when they are impacted against a rigid target of known properties. Physical characteristics of the test items to be varied are: (1) diameter, (2) thickness, (3) filler material, and (4) material of construction. The magnitude of the effects of impact are studied by measuring: (1) rupture velocity of impact, (2) impact pressure, (3) rebound velocity, (4) contact time, and (5) other quantities as circumstances dictate. With the results of the tests, a least squares method is used to establish an empirical equation relating rupture velocity and the variable parameters. During the present report period considerable progress was made on the theoretical analysis of both hollow cylinders and hollow spheres subjected to impact loads. A comparison of the impact effects on a short cylinder with a hemispherical end and a hollow sphere was made. (M.O.W.)

26590 EURATOM—A REVIEW OF DEVELOPMENT AND ACTIVITY. Baehr, P. (EURATOM, Brussels). Atompraxis, 12: 196-202(Apr.-May 1966). (In German).

Various reasons that prompted pooling of the research effort are explained, and a detailed account of the research setup, with research being carried out directly by Euratom at its own centers and indirectly by means of association and research contracts is given. A review of Euratom's activity in the year 1965 records the progress of work in the various research fields. New responsibilities that are to be tackled in the third research program at present in preparation are discussed. (auth)

26591 THE CENTRAL BUREAU FOR NUCLEAR MEASUREMENTS: EURATOM'S BUREAU OF NUCLEAR STANDARDS. Spaepen, J. (EURATOM, Geel, Belg.). Atompraxis, 12: 205-7(Apr.-May 1966). (In German).

The Euratom Treaty provides for the setting-up of a Central Bureau for Nuclear Measurements (CBNM), specializing in nuclear measurements for isotope analyses and in the absolute measurement of radiation and neutron absorption. The setting up of this Bureau as a Euratom JRC establishment was initiated at Geel, Belgium, in 1960. Its tasks are the creation of primary standards and their comparison with those of other laboratories; improvement of measurement devices and methods; accurate measurement of nuclear data; basic research; analytical and measuring operations on behalf of outside parties—all within the nuclear field. The CBNM is engaged in neutron measurements, isotope analyses, and absolute counting of radionuclides. The CBNM has created a central laboratory which supplies on request analyzed samples for nuclear measurements. These samples are prepared by a number of techniques—metallurgical electrolysis, electrospraying, evaporation, etc. About 2500 samples were prepared in 1965. Priority is accorded to neutron-measurements standards. (auth)

26592 COST OF THE BASIC MATERIALS FOR ENERGY PRODUCTION. Muysken, M. Atoomenergi Haar Toepass., 8e: 33-37(Feb. 1966). (In Dutch).

The relative costs of the primary materials of energy production under present circumstances and the effect of possible future cost increases of the primary materials on the energy cost are considered. It was concluded that a price increase of uranium from $8 to $15 per pound of U_3O_8 would mean only a 4 to 6% increase in the energy cost. An additional increase of the cost of uranium to $30 per pound of U_3O_8 would have, for water-cooled reactors, an effect on the energy cost corresponding to an increase in the cost of fossil fuels from $12 to $16 per coal equivalent. (tr-auth)

CORPORATE AUTHOR INDEX

This index contains entries for this period for all report literature and, in addition, for certain published literature items for which it is felt that a corporate approach is especially desirable, e.g., symposia, conference proceedings, and meetings.

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Because of problems involving the mechanical preparation of this index, all accent marks are omitted. The following changes in spelling have been introduced to reduce some of the confusion which might result from omitting the accents:

ä	becomes	ae
ö		oe
ø		oe
ü		ue (except in transliterated Chinese names)

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SUBJECT INDEX

Main entries in this index are generally specific materials, things, and processes. These are followed by modifiers that describe the properties of, and processes applied to, the main entries.

The number preceding the colon is the *NSA* volume number, and the number following is the abstract number. The designation (R) following the abstract number indicates that the abstract is of a progress report; (P) indicates a patent; and (T) indicates a translation. Abstracts for reports other than progress reports carry no letter designation. References to report numbers, where appropriate, are included after the abstract number of the citation. Published literature (journal article or book) is identifiable by the absence of a report number.

The user should bear in mind that the ideas presented in the original literature, rather than key words, have been indexed. The indexers have tried to select what seemed the most probable and logical place to look for typical information. Since it is not possible to anticipate where a user would look for information, numerous cross references are included in cumulative indexes to assist him in his search.

Experience in using an index of this type will be the best guide in obtaining the desired information, and a consideration of synonymous or closely related terms will prove valuable.

Information must be so indexed as to be of the greatest use to the greatest number of users. This requires that a topic be indexed to headings that most specifically describe it and not ordinarily to the headings that describe its ultimate use, nor to the general class headings that include the specific headings. For example, information on the treatment of thyroid disease with I-131 would be indexed under Thyroid Gland and under Iodine Isotopes I-131, but not necessarily under Radiotherapy. A study of the effects of x radiation on hair would be indexed under both X Radiation and Hair. However, the information would not be indexed under the experimental animal, e.g., Rats, unless the report discusses the effects on rat hair as compared with the effect on the hair of other animals.

The broad, general class headings are used only for general information or for comprehensive reports or articles.

Subject Heading Styles

Generally, the direct form of subject entry is used rather than inverted headings, e.g., Amino Acids rather than Acids, Amino; Helium Isotopes He-4 rather than Helium—isotopes He-4 or Helium—He-4 isotopes. Note, however, that in some cases parenthetic modifying terms or inverted headings of the form Neutrons, Fast are used in preference to a direct entry that would result in the scattering of information. Organic compounds are usually entered in the index in the inverted form so that substituted compounds can be listed near the parent compound; e.g., Benzene, Bromo- rather than Bromobenzene. In general, the style of nomenclature used is that of Chemical Abstracts, except that some items listed in that publication as subheadings are elevated to form part of the main heading; e.g., Butyric Acid, Methyl Ester rather than Butyric Acid—methyl ester.

Alphabetization

Main headings are alphabetized word-by-word. A parenthetic qualifier following a main heading is disregarded in alphabetizing unless there are two or more headings identical except for the parenthetic qualifier, in which case the qualifier determines the order. Headings involving Greek letters are arranged as if the names of the letters were spelled out.

Examples:

M-Capture
  see Electron Capture
Magnesium
Magnesium Alloys
Manganese Fluorides
Manganese(II) Fluorides
Mesons
Mesons (π)
Mesons (ρ)
3-Pentanol, 2,4-Dimethyl-
2-Pentanol, 2-Methyl-
2-Pentanol, 4-Methyl-

Nomenclature of Inorganic Compounds

Inorganic compounds are indexed in the direct form, listing cations in the order of increasing valence in the case of polycationic salts of varying valence and in alphabetic order for polycationic salts in which all cations have the same valence; e.g., Sodium Aluminum Silicates and Potassium Sodium Sulfates.

Multicomponent Alloys and Other Systems

Multicomponent alloys, except well-known trade names, are indexed under a main heading in the form "element alloy" for each element in the alloy. The modifier begins with element symbols for each component arranged alphabetically as if the English name for the element were spelled out.

Example: Copper-Gold Alloy is indexed
  Copper Alloys
    Cu-Au...
  Gold Alloys
    Cu-Au...

Well-known alloys such as Zircaloy-2 are indexed directly to the trade name; cross references referring from each component of the alloy to the entry for the trade name appear in cumulative indexes.

Multicomponent systems of non-metallic elements are indexed in a manner similar to alloys except the main heading used contains the word "Systems" in place of "Alloys."

Example: Silicon–Tungsten Systems are indexed
  Silicon Systems
    Si-W...
  Tungsten Systems
    Si-W...

Multicompound systems and mixtures of compounds are indexed under the main heading for each component com-

pound; the modifiers begin with an alphabetical listing of compound formulas.

Example: Lead Titanate–Lead Zirconate is indexed
Lead Titanates
$PbTiO_3$-$PbZrO_3$...
Lead Zirconates
$PbTiO_3$-$PbZrO_3$...

A mixed system of compounds and elements is indexed using a combined form of the above conventions, e.g., a dispersion of copper and alumina would be indexed

Aluminum Oxides
Al_2O_3-Cu...
Copper Systems
Al_2O_3-Cu..

Physical States and Configurations of Materials

Specification of the physical state, if other than normal, or geometric configuration of the material is included in the modifying phrase, i.e., liquid metals would be indexed to the metal with "liquid" in the modifier, and carbon crucibles would be indexed to Carbon with "crucibles" appropriately placed in the modifier and also to Crucibles if appropriate.

Modifying Phrases

The modifiers appearing under a main heading are written specifically to describe the relation of the item being indexed to that main heading. The modifier, therefore, will generally contain more useful information about that relation than will a title or a phrase written to be used under every main heading assigned to the item. Effort is exerted to begin the modifier with the word judged to be of greatest use to the greatest number of users; this, however, does not obviate the need to consider all modifiers under the main heading(s) of interest.

Modifiers are usually intended to form a meaningful phrase when combined with the main heading. Some are intended to be read following the main heading, e.g., the entry Hydrogen—sorption by charcoal is read "hydrogen sorption by charcoal"; however, as a result of placing the important word first, many modifiers must be arranged for smooth reading, e.g., Formaldehyde—yields in radiolysis of ethyl ether, effects of deuterium on is read "effects of deuterium on formaldehyde yields in radiolysis of ethyl ether" and Uranium—crystal structure of, effect of cooling rate on allotropic transformations in is read "effect of cooling rate on allotropic transformations in crystal structure of uranium." Prepositions are sometimes omitted if no ambiguity results.

Special characters are added to modifiers in the field of physics; if the modifier does not establish the experimental or theoretical character of a reference, a symbol (E), (T), or (E/T) is placed immediately after the modifying phrase and before the journal reference number. The value of this identification has been established by the American Institute of Physics.

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631987	20-26340	CFSTI $1.00 cy, $0.50 mn
632283	20-24972	CFSTI $1.00 cy, $0.50 mn
632284	20-25375	CFSTI $1.00 cy, $0.50 mn
632461	20-25118	CFSTI $1.00 cy, $0.50 mn
632528	20-24973	CFSTI $1.00 cy, $0.50 mn
632831	20-25509	CFSTI $2.00 cy, $0.50 mn
AE–	**(Non-AEC)**	
224	20-24836	Dep. mn
225	20-26548	Dep. mn
AEC-tr–	**(For complete listing see TID-4025)**	
6670	20-26260	Dep. mn
AECD-CH–	**(Pakistani)**	
8	20-25464	Dep. mn
AECD-EP–	**(Pakistani)**	
9	20-25376	Dep. mn
AECD-HP–	**(Pakistani)**	
4	20-25649	Dep. mn
AECL–	**(Canadian)**	
2330	20-26468	Dep. mn. AECL $6.00
2415	20-26530	Dep. mn. AECL $0.75
2420	20-26531	Dep. mn. AECL $1.00
AED-C–	**(Non-AEC)**	
06-13	20-25377	Dep. mn
22-05	20-26516	Dep. mn
AERE-R–	**(British)**	
3937	20-25493	J. Inorg. Nucl. Chem., 28: 1191-1203(1966)
4584	20-26393	Dep. BIS $2.50. HMSO 12s.
4967	20-25411	J. Nucl. Energy, Pt. A/B, 20: 185-90(1966)
5097	20-24969	Dep. BIS $5.40. HMSO 27s. 0d.
5181	20-25119	Dep. BIS $0.50. HMSO 2s. 6d.
AFRRI-SR–	**(Non-AEC)**	
66-2	20-24872	
66-3	20-25378	
AGN–	**(Misc.)**	
8135	20-25462	Dep. mn. CFSTI $5.00 cy, $1.00 mn
AGN-TM–		
415	20-26458	Dep. mn. CFSTI $6.00 cy, $1.25 mn
AI–	**(Misc.)**	
65-42	20-26025	See N-65-35450
AMRA-CR–	**(Non-AEC)**	
66-02/1	20-25509	See AD-632831
ANL–		
6953	20-25379	Dep. mn. CFSTI $4.00 cy, $0.75 mn
6962	20-26532	Dep. mn. CFSTI $6.00 cy, $1.50 mn
7049	20-26420	Dep. mn. CFSTI $1.00 cy, $0.50 mn
7075	20-25522	Dep. mn. CFSTI $1.00 cy, $0.50 mn
7133	20-26421	Dep. mn. CFSTI $1.00 cy, $0.50 mn
7146	20-25031	Dep. mn. CFSTI $2.00 cy, $0.50 mn
7193	20-26394	Dep. mn. CFSTI $4.00 cy, $0.75 mn
ARDG(FE)J–	**(Japanese)**	
223	20-24871	See AD-625949
ARL–	**(Non-AEC)**	
66-0018	20-25716	See AD-631601
AWRE-O–	**(British)**	
19/66	20-25559	Dep. BIS $1.10. HMSO 5s. 6d.
BAW–	**(Misc.)**	
393-5	20-26080	Dep. mn. CFSTI $3.00 cy, $0.75 mn
BM-RI–	**(Misc.)**	
6781	20-25032	Bureau of Mines Free
BNL–		
946	20-25717	Dep. mn. CFSTI $1.00 cy, $0.50 mn
954	20-26586	Dep. mn. CFSTI $5.00 cy, $1.00 mn
980	20-25475	Dep. mn. CFSTI $2.00 cy, $0.50 mn
9038	20-24931	Proc. Soc. Exp. Biol. Med., 121: 1275-9(1966)
9346	20-24998	J. Lab. Clin. Med., 67: 836-49(1966)
9493	20-26237	pp 313-20 of Preludes in Theoretical Physics. Amsterdam, North-Holland Publishing Co., 1966
9512	20-26019	pp 231-9 of Preludes in Theoretical Physics. Amsterdam, North-Holland Publishing Co., 1966
9560	20-25140	J. Chem. Phys., 44: 3426-31(1966)
9561	20-25141	J. Chem. Phys., 44: 3431-6(1966)
9796	20-25423	Rev. Sci. Instrum., 37: 666-7(1966)
9822	20-26174	Phys. Rev., 145: 894-900(1966)
10058	20-26422	Dep. mn. CFSTI $2.00 cy, $0.50 mn
10136	20-25834	Phys. Rev. Lett., 16: 855-60(1966)
10137	20-25301	Dep. mn. CFSTI $1.00 cy, $0.50 mn
10138	20-26395	Dep. mn. CFSTI $1.00 cy, $0.50 mn
10139	20-26534	Dep. mn. CFSTI $2.00 cy, $0.50 mn
10166	20-25778	Dep. mn. CFSTI $3.00 cy, $0.75 mn
BNWL–		
241	20-25304	Dep. mn. CFSTI $1.00 cy, $0.50 mn
BNWL-SA–		
148	20-24903	Health Phys., 12: 609-13(1966)
198	20-25328	Health Phys., 12: 605-8(1966)
519	20-25380	Dep. mn. CFSTI $1.00 cy, $0.50 mn
614	20-26423	Dep. mn. CFSTI $1.00 cy, $0.50 mn
CALT–		
221-15	20-26022	Dep. mn. CFSTI $1.00 cy, $0.50 mn
CAPE–		
1331	20-25363	
1332	20-25362	
1335	20-25023	
1350	20-25431	
1355	20-25432	
1356	20-25531	
CCDN-CI–		
7	20-26088	See NYO-72-73
CEA-Bib–	**(French)**	
43	20-25476	Dep. mn
67	20-26341	Dep. mn
CEA-R–	**(French)**	
2819	20-25560	Dep. mn
2821	20-26342	Dep. mn
2838	20-25779	Dep. mn
2842	20-25033	Dep. mn
2857	20-25561	Dep. mn
2896	20-26061	Dep. mn
2912	20-25718	Dep. mn
2913	20-25719	Dep. mn
2922	20-24852	Dep. mn
2930	20-25281	Dep. mn
2935	20-26239	Dep. mn
2971	20-26062	Dep. mn
2977	20-26424	Dep. mn
CERN–	**(European Organization for Nuclear Research)**	
66-13	20-25780	Dep. mn

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66-14	20-25381	Dep. mn
CERN-HER–	**(European Organization for Nuclear Research)**	
AP-1-66	20-24853	Dep. mn
CEX–		
59.4.23	20-25319	Dep. mn. CFSTI $1.00 cy, $0.50 mn
65.01	20-26063	Dep. mn. CFSTI $1.00 cy, $0.75 mn
CLM-P–	**(British)**	
85	20-26284	Phys. Fluids, 9: 956-64(1966)
CONF-242–	**20-25228**	**(American Institute of Chemical Engineers Symposium, Chicago, Ill., Dec. 1962) Chem. Eng. Progr., 61: Symp. Ser. No. 60, 1-185(1965)**
CONF-523–	**20-26538**	**(IAEA Study Group Meeting on Operational Problems of Research Reactors and Their Use for Isotope Production and Activation Analysis, Manila, Dec. 1963) See STI/DOC-58**
CONF-526–	**(Libby/Cockcroft US/UK Meeting on Graphite Chemistry, Richland, Wash., May 1964)**	
2	20-25122	See HW-SA-3440
CONF-550–	**(The International Conference on High-Energy Physics, Dubna, Aug. 5–15, 1964)**	
Vol.1	20-25950	
CONF-606–	**(American Chemical Society, Northwest Regional Meeting, Spokane, Wash., June 1964)**	
7	20-25122	See HW-SA-3440
CONF-631104–	**20-26537**	**(Meeting on the Utilization of Research Reactors, Sao Paulo, Brazil, Nov. 4–8, 1963) See STI/DOC-57**
CONF-640308–	**20-25166**	**(Nuclear and Radiation Chemistry Symposium, Bombay, Mar. 16–19, 1964) Trombay, India, Atomic Energy Establishment, 1965.**
CONF-640618–	**20-25532**	**(Symposium on Powder Metallurgy, Paris, June 15–17, 1964) Saint-Germain-en-Laye, France, Editions Metaux, [1965]**
CONF-640923–	**20-25189**	**(5th Session of the Consultative Committee for Standards of Measurement of Ionizing Radiations, Sevres, France, Sept. 28–29, 1964) Paris, Gauthier-Villars and Cie, [1964]**
CONF-650218–	**20-24256**	**(International University Sessions on Nuclear Physics, Schladming, Austria, Feb. 25–Mar. 10, 1965) Acta Phys. Austr., Suppl. II, 1-245(1965)**
2	20-25878	See DESY-66/7
CONF-650425–	**20-26350**	**(Panel on the Uses of the Mössbauer Effect in Chemistry and Solid State Physics, Vienna, Apr. 26–30, 1965) See STI-DOC-10/50**
CONF-650607–	**(American Society of Mechanical Engineers, Berkeley, June 1965)**	
2	20-25563	See EURAEC-1350
CONF-650671–	**20-26488**	**(Conference on Possibility and Foreseeable Development of Experimental Reactor Types, Rome, June 24–25, 1965) Rome, Comitato Nazionale Energia Nucleare, 1966**
CONF-650804–	**(5th Rare Earth Research Conference, Ames, Iowa, Aug. 30–Sept. 1, 1965)**	
Bk.1	20-25100	ORAU
CONF-650902–	**(American Chemical Society, 150th National Meeting, Atlantic City, Sept. 12–17, 1965)**	
13	20-25468	See MLM-1293
CONF-651004–	**(9th Conference on Analytical Chemistry in Nuclear Technology, Gatlinburg, Tenn., Oct. 12, 1965)**	
15	20-24976	See GAT-524
CONF-651007–	**(Society of Petroleum Engineers, 40th Annual Fall Meeting, Denver, Oct. 3–6, 1965)**	
2	20-25234	ORAU
CONF-651015–	**(American Physical Society, Chicago, Oct. 7, 1965)**	
23	20-25780	See CERN-66-13
CONF-651017–	**20-25495**	**(Electrochemical Society Meeting, Buffalo, Oct. 10–14, 1965) Electrochem. Technol., 4: 77-162(1966)**
5	20-25506	ORAU. Gmelin, AED-CONF-65-289-3
10	20-25607	ORAU. Gmelin, AED-CONF-65-289-9
11	20-25609	ORAU. Gmelin, AED-CONF-65-289-14
CONF-651019–	**(15th Canadian Chemical Engineering Conference, Quebec City, Canada, Oct. 25, 1965)**	
3	20-25212	ORAU. Gmelin, AED-CONF-65-294-5
CONF-651031–	**(American Society of Metals Meeting, Detroit, Oct. 19, 1965)**	
3	20-25608	ORAU. Gmelin, AED-CONF-65-331-3
CONF-651048–	**(Society of Automotive Engineers, Combined Powerplant and Transportation Meeting, Cleveland, Oct. 18–21, 1965)**	
1	20-25227	ORAU
CONF-651055–	**20-24969**	**(Preparation and Standardization of Isotopic Targets and Foils. Conference, Harwell, England, Oct. 20–21, 1965) See AERE-R-5097**
CONF-651103–	**(IAEA Symposium on Criticality Control of Fissile Materials, Stockholm, Nov. 1–5, 1965)**	
29	20-26425	See DP-1014
CONF-651109–	**(1st Symposium on Accelerator Radiation Dosimetry and Experience, Upton, N. Y., Nov. 3–5, 1965)**	
22	20-25657	See SLAC-PUB-179
CONF-651202–	**(Symposium on Practices in the Treatment of Low and Intermediate Level Radioactive Waste, Vienna, Dec. 6–10, 1965)**	
5	20-26570	ORAU
6	20-26571	ORAU
7	20-26572	ORAU
8	20-26573	ORAU
9	20-26553	ORAU
12	20-26554	ORAU
13	20-26555	ORAU
14	20-26556	ORAU
15	20-26557	ORAU
16	20-26580	ORAU
17	20-26581	ORAU
18	20-26558	ORAU
20	20-26582	ORAU
21	20-26583	ORAU
23	20-26584	ORAU
24	20-26559	ORAU
25	20-26560	ORAU
26	20-26574	ORAU
28	20-26561	ORAU
29	20-26562	ORAU
30	20-26575	ORAU
31	20-26576	ORAU
33	20-26406	ORAU
34	20-26563	ORAU
35	20-25337	ORAU
36	20-26564	ORAU
37	20-26565	ORAU
38	20-26566	ORAU
40	20-26577	ORAU
41	20-26578	ORAU
42	20-26567	ORAU
43	20-26568	ORAU
45	20-26579	ORAU
46	20-26569	ORAU

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CONF-660211–	**(1st Midwest Symposium on Nondestructive Testing of Welds, Chicago, Feb. 1–4, 1966)**	
2	20-25268	See ORNL-P-2107
CONF-660303–	**(American Physical Society, Conference of Neutron Cross Section Technology, Washington, D. C., Mar. 22–24, 1966)**	
1	20-26422	See BNL-10058
2	20-26333	Dep. mn. CFSTI $1.00 cy, $0.50 mn
3	20-26097	See UCRL-14568
14	20-26423	See BNWL-SA-614
17	20-26086	See LA-DC-7623
27	20-26092	See ORNL-P-2072
28	20-26093	See ORNL-P-2106
CONF-660304–	**(Institute of Electrical and Electronics Engineers, Scintillation and Semiconductor Counter Symposium, Washington, D. C., Mar. 2–4, 1966)**	
6	20-25389	See UCRL-16724
7	20-25388	See UCRL-16539
CONF-660306–	**(American Physical Society, Conference on Isobaric Spin, Tallahassee, Mar. 17–19, 1966)**	
5	20-26094	See ORNL-P-2117
CONF-660312–	**(Nederlands Atoomforum, Utrecht, Netherlands, Mar. 15, 1966)**	
3	20-25301	See BNL-10137
4	20-26395	See BNL-10138
5	20-26534	See BNL-10139
CONF-660316–	**(AACC 5th Annual Technical Meeting and Exhibit, Houston, Mar. 29, 1966)**	
1	20-25323	See SC-R-66-865
CONF-660317–	**(Field Ion Microscopy Conference, Gainesville, Fla., Mar. 1966)**	
1	20-26351	See UCRL-16777
CONF-660319–	**(American Society for Metals Sessions, WESTEC Conference, Los Angeles, Mar. 1966)**	
2	20-25346	See SC-R-66-871
CONF-660412–	**(Symposium on Accidental Irradiation at Place of Work, Nice, France, Apr. 25–29, 1966)**	
1	20-25386	See ORNL-P-2105
CONF-660413–	**(Conference on Application of Physico-Chemical Methods in Chemical Analysis, Budapest, Apr. 20–23, 1966)**	
1	20-25196	See INR-677/V/XIII/C
CONF-660505–	**(American Ceramic Society Meeting, Washington, D. C., May 7–12, 1966)**	
3	20-25574	See SC-DC-66-1509
CONF-660507–	**(Symposium for the Disposal of Radioactive Wastes into Sea, Oceans, and Surface Waters, Vienna, May 17, 1966)**	
3	20-25282	See RLO-1750-4
CONF-660510–	**(International Conference on Isochronous Cyclotrons, Gatlinburg, Tenn., May 2–5, 1966)**	
1	20-25660	See UCRL-16726
3	20-25659	See UCRL-16708
CONF-660511–	**(International Symposium on Capsule Irradiation Experiments, Pleasanton, Calif., May 3–5, 1966)**	
2	20-26515	See DUN-SA-7
CONF-660520–	**(International Symposium on the Decontamination of Nuclear Installations, Harwell, England, May 4–6, 1966)**	
1	20-26531	See AECL-2420
CONF-660521–	**(International Symposium on In-Pile Irradiation Equipment and Techniques, Harwell, England, May 10–12, 1966)**	
1	20-26530	See AECL-2415
CONF-660522–	**(National Conference of Standards Labs., Annual Meeting, Gaithersburg, Md., May 8–12, 1966)**	
1	20-25345	See SC-DC-66-1491
CONF-660524–	**(2nd International Thorium Fuel Cycle Symposium, Gatlinburg, Tenn., May 3–6, 1966)**	
1	20-25466	See DUN-SA-11
2	20-25525	See ORNL-TM-1501
CONF-660606–	**(American Nuclear Society Meeting, Denver, June 19–23, 1966)**	
2	20-25380	See BNWL-SA-519
COO–		
264-253	20-25948	pp 199-204 of Preludes in Theoretical Physics. Amsterdam, North-Holland Publishing Co., 1966
264-259	20-25871	pp 133-42 of Preludes in Theoretical Physics. Amsterdam, North-Holland Publishing Co., 1966
427-49	20-26107	Ann. Phys. (N. Y.), 37: 55-61(1966)
1195-56	20-25781	Dep. mn. CFSTI $2.00 cy, $0.50 mn
1198-323	20-26300	Rev. Sci. Instrum., 37: 678-9(1966)
1233-23(Rev.)	20-26287	Phys. Fluids, 9: 997-1009(1966)
1420-121	20-26173	Phys. Rev., 145: 887-93(1966)
CRWR–		
10	20-24833	See TID-22877
CU–	**(Misc.)**	
2791-5	20-25121	Dep. mn. CFSTI $1.00 cy, $0.50 mn
CVNA–	**(Misc.)**	
256	20-26460	Dep. mn. CFSTI $3.00 cy, $0.75 mn
D–	**(Misc.)**	
1-82-0502	20-26240	Dep. mn
DC–	**(Misc.)**	
60-4-87	20-26334	Dep. mn. CFSTI $2.00 cy, $0.50 mn
DESY–	**(German)**	
65/18	20-25650	Dep. mn
66/3	20-25651	Dep. mn
66/5	20-25652	Dep. mn
66/6	20-25998	Dep. mn
66/7	20-25878	Dep. mn
66/8	20-25782	Dep. mn
DP–		
1014	20-26425	Dep. mn. CFSTI $3.00 cy, $0.75 mn
1019	20-25615	Dep. mn. CFSTI $3.00 cy, $0.75 mn
DPSPU–		
64-30-13	20-25271	Mater. Eval., 24: 253-6(1966)
DUBNA REPORTS	**(Russian)**	
See JINR (Russian)		
DUN-SA–		
7	20-26515	Dep. mn. CFSTI $1.00 cy, $0.50 mn
11	20-25466	Dep. mn. CFSTI $1.00 cy, $0.50 mn
EANDC–	**(European-American Nuclear Data Committee)**	
54(U)	20-26088	See NYO-72-73
ECOM–	**(Non-AEC)**	
01313-3	20-25446	See AD-631705
01520-2	20-25445	See AD-631266
EFINS–	**(Misc.)**	
65-33	20-25948	See COO-264-253
65-41	20-25871	See COO-264-259
65-103	20-25677	See N-66-15458
EHE–		
01-6602	20-24833	See TID-22877
10-6404	20-24832	See TID-22872
12-6405	20-24834	See TID-22878
EIMAC-TR–	**(Non-AEC)**	
66-2	20-25562	
EOS–	**(Non-AEC)**	
4010-Final	20-25274	See N-65-32573
6952-Q-1	20-25765	See N-65-35354

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EUR–	**(European Atomic Energy Community)**	
1616.e	20-26461	
2080	20-25523	See EURAEC-1277
2325.e	20-25563	See EURAEC-1350
2604.f	20-25719	See CEA-R-2913
2630.f	20-25718	See CEA-R-2912
2644.f	20-25281	See CEA-R-2930
2645.f	20-26239	See CEA-R-2935
2801	20-25524	See EURAEC-1562
EURAEC–		
1277	20-25523	Dep. mn. CFSTI $3.00 cy, $0.75 mn
1350	20-25563	Dep. mn. CFSTI $3.00 cy, $0.75 mn
1562	20-25524	Dep. mn. CFSTI $3.00 cy, $0.75 mn
1596	20-26463	See GEAP-5080
1597	20-26464	See GEAP-5083
1599	20-25616	See GEAP-5085
1603	20-25241	See GEAP-5093
1606	20-25242	See GEAP-5094
EURFNR–	**(Misc.)**	
43F	20-26471	Dep. mn. CFSTI $4.00 cy, $0.75 mn
77F	20-26472	Dep. mn. CFSTI $2.00 cy, $0.50 mn
F–	**(Misc.)**	
B2028-1	20-25568	See N-65-33505
FR–	**(Non-AEC)**	
66-17-57	20-25446	See AD-631705
GA–	**(Misc.)**	
5104	20-26462	Dep. mn. CFSTI $5.00 cy, $1.00 mn
GACD–	**(Non-AEC)**	
5678	20-25618	See N-65-33506
GAT–		
524	20-24976	Dep. mn. CFSTI $1.00 cy, $0.50 mn
GDA-DBE–	**(Non-AEC)**	
64-052-4	20-25275	See N-65-33367
GEAP–	**(Misc.)**	
5080	20-26463	Dep. mn. CFSTI $1.00 cy, $0.50 mn
5083	20-26464	Dep. mn. CFSTI $1.00 cy, $0.50 mn
5085	20-25616	Dep. mn. CFSTI $2.00 cy, $0.50 mn
5093	20-25241	Dep. mn. CFSTI $2.00 cy, $0.50 mn
5094	20-25242	Dep. mn. CFSTI $2.00 cy, $0.50 mn
HASL–		
66-4	20-25343	Dep. mn. CFSTI $2.00 cy, $0.50 mn
HN–		
183	20-25230	Dep. mn. CFSTI $5.00 cy, $1.00 mn
HW-SA–		
3440	20-25122	Dep. mn. CFSTI $1.00 cy, $0.50 mn
IBJ–	**(Polish)**	
See INR		
IC–	**(Misc.)**	
66/30	20-25879	Dep. mn
66/34	20-25880	Dep. mn
66/35	20-25881	Dep. mn
66/41	20-25882	Dep. mn
66/42	20-25883	Dep. mn
66/44	20-25884	Dep. mn
IDO–		
12051	20-25320	Dep. mn. CFSTI $2.00 cy, $0.50 mn
17126	20-26517	Dep. mn. CFSTI $3.00 cy, $0.75 mn
17140	20-26396	Dep. mn. CFSTI $4.00 cy, $0.75 mn
17145	20-26518	Dep. mn. CFSTI $4.00 cy, $0.75 mn
17173	20-26081	Dep. mn. CFSTI $2.00 cy, $0.50 mn
17174	20-26082	Dep. mn. CFSTI $1.00 cy, $0.50 mn
28653	20-26465	Dep. mn. CFSTI $3.00 cy, $0.75 mn
IFA-FR–	**(Rumanian)**	
47	20-26426	Dep. mn
48	20-26064	Dep. mn
IFA-IS–	**(Rumanian)**	
35	20-25034	Dep. mn
IFJ–	**(Polish)**	
See INP		
INDEC-SR–	**(Non-AEC)**	
6	20-25572	See NASA-CR-67221
INR–	**(Non-AEC)**	
639/III/E	20-25344	Dep.
643/XIV/PB	20-25564	Dep.
654/XVIII/PP	20-25762	Dep.
658/IX/R	20-25243	Dep.
662/VII/PH	20-25783	Dep.
666/XIV/PS	20-25565	Dep.
672/XVII/C	20-25123	Dep.
677/V/XIII/C	20-25196	Dep.
IPP–	**(Non-AEC)**	
1/43	20-26241	Dep. mn
1/47	20-25720	Dep. mn
2/46	20-26242	Dep. mn
3/33	20-26243	Dep. mn
IPPJ–	**(Japanese)**	
47	20-26244	Dep. mn
IS–		
1199	20-25472	J. Sci. Instrum., 43: 134-7(1966)
IS-T–		
77	20-26343	Dep. mn. CFSTI $3.00 cy, $0.75 mn
ISS–	**(Italian)**	
65/49	20-26083	Dep. mn
66/1	20-25784	Dep. mn
ITEF–	**(Russian)**	
402	20-26399	Dep. mn
JINR–	**(Russian)**	
D-2710	20-25035	Dep. mn
P-2582	20-25785	Dep. mn
P-2588	20-25653	Dep. mn
P-2618	20-26084	Dep. mn
P-2624	20-26085	Dep. mn
P-2630	20-25786	Dep. mn
P-2631	20-25885	Dep. mn
P-2632	20-25787	Dep. mn
JPL-TR–	**(Non-AEC)**	
32-532	20-25571	See N-66-16152
32-806	20-26023	
JPRS–	**(Non-AEC)**	
34566	20-25576	CFSTI $6.00 cy, $1.25 mn
K–		
1653	20-25467	Dep. mn. CFSTI $4.00 cy, $0.75 mn
K-Trans–		
17	20-25469	Dep. mn. JCL $2.60 fs, $0.92 mf
KAPL–		
3120	20-25566	Dep. mn. CFSTI $2.00 cy, $0.50 mn
LA–		
3369	20-26245	Dep. mn. CFSTI $3.00 cy, $0.50 mn
3416	20-26246	Dep. mn. CFSTI $4.00 cy, $0.75 mn
3439	20-25988	Dep. mn. CFSTI $3.00 cy, $0.50 mn
3475	20-25721	Dep. mn. CFSTI $5.00 cy, $1.00 mn
LA-DC–		
7335	20-25066	J. Inorg. Nucl. Chem., 28: 1205-8(1966)
7623	20-26086	Dep. mn. CFSTI $1.00 cy, $0.80 mn
7698	20-25058	Inorg. Nucl. Chem. Lett., 2: 19-21(1966)
LA-tr–		
66-22	20-25577	Dep. mn. JCL $1.60 fs, $0.80 mf

Report No.	Abstract No.	Availability
LAL–	**(French)**	
1154	20-26087	Dep. mn
LNF–	**(Italian)**	
65/48	20-25654	Dep. mn
66/16	20-25788	Dep. mn
MIT–	**(Misc.)**	
2098-232	20-26156	Phys. Lett., 21: 209-10(1966)
MLM–		
1293	20-25468	Dep. mn. CFSTI $1.00 cy, $0.50 mn
MPI-PAE–	**(German)**	
P1.21/65	20-26247	Dep. mn
MSAR–	**(Misc.)**	
66-71	20-25567	Dep. mn. CFSTI $2.00 cy, $0.50 mn
N–	**(Misc.)**	
65-15226	20-25273	CFSTI $3.00 cy, $0.75 mn
65-15252	20-25763	CFSTI $4.00 cy, $0.75 mn
65-32573	20-25274	CFSTI $4.00 cy, $0.75 mn
65-32965	20-25764	CFSTI $2.00 cy, $0.50 mn
65-33300	20-26248	
65-33367	20-25275	CFSTI $3.00 cy, $0.75 mn
65-33370	20-25617	CFSTI $3.00 cy, $0.50 mn
65-33505	20-25568	CFSTI $4.00 cy, $0.75 mn
65-33506	20-25618	CFSTI $1.00 cy, $0.50 mn
65-34908	20-25463	CFSTI $1.00 cy, $0.50 mn
65-34948	20-26344	CFSTI $1.00 cy, $0.50 mn
65-35213	20-25569	CFSTI $2.00 cy, $0.50 mn
65-35246	20-25751	CFSTI $2.00 cy, $0.50 mn
65-35248	20-25244	CFSTI $1.00 cy, $0.50 mn
65-35269	20-25951	CFSTI $1.00 cy, $0.50 mn
65-35317	20-24873	CFSTI $2.00 cy, $0.50 mn
65-35350	20-25276	CFSTI $3.00 cy, $0.75 mn
65-35354	20-25765	CFSTI $3.00 cy, $0.75 mn
65-35356	20-26024	CFSTI $3.00 cy, $0.75 mn
65-35410	20-25277	CFSTI $1.00 cy, $0.50 mn
65-35413	20-25789	CFSTI $1.00 cy, $0.50 mn
65-35450	20-26025	CFSTI $2.00 cy, $0.50 mn
65-35524	20-24945	CFSTI $1.00 cy, $0.50 mn
65-35576	20-25766	CFSTI $1.00 cy, $0.50 mn
65-35787	20-25578	CFSTI $2.00 cy, $0.50 mn
65-35957	20-25570	CFSTI $2.00 cy, $0.50 mn
65-35969	20-25225	CFSTI $2.00 cy, $0.50 mn
65-36441	20-25382	CFSTI $2.00 cy, $0.50 mn
65-36757	20-25768	CFSTI $1.00 cy, $0.50 mn
65-36897	20-26249	CFSTI $1.00 cy, $0.50 mn
66-15448	20-25447	CFSTI $2.00 cy, $0.50 mn
66-15458	20-25677	CFSTI $1.00 cy, $0.50 mn
66-15495	20-26519	CFSTI $4.00 cy, $1.00 mn
66-15632	20-25383	CFSTI $3.00 cy, $0.75 mn
66-15788	20-25278	CFSTI $3.00 cy, $0.75 mn
66-16076	20-25384	CFSTI $5.00 cy, $1.00 mn
66-16152	20-25571	CFSTI $2.00 cy, $0.50 mn
NAA-SR–		
11202	20-26466	Dep. mn. CFSTI $3.00 cy, $0.75 mn
NASA-CR–	**(Misc.)**	
370	20-26519	See N-66-15495
446	20-26250	CFSTI $1.25 cy
447	20-26520	CFSTI $4.00 cy, $0.50 mn
54062	20-25274	See N-65-32573
54102	20-25273	See N-65-15226
54245	20-25275	See N-65-33367
54256	20-25763	See N-65-15252
54647	20-25562	See EIMAC-TR-66-2
54743	20-25225	See N-65-35969
54848	20-26521	
54861	20-25278	See N-66-15788
54892	20-25575	See WANL-PR-(Q)-008
54912	20-25484	
59709	20-25384	See N-66-16076
64847	20-25618	See N-65-33506
64849	20-25568	See N-65-33505
65142	20-25617	See N-65-33370
65157	20-25382	See N-65-36441
67016	20-26024	See N-65-35356
67190	20-26025	See N-65-35450
67205	20-26344	See N-65-34948
67221	20-25572	CFSTI $3.00 cy, $0.75 mn
67299	20-25765	See N-65-35354
67316	20-25276	See N-65-35350
67317	20-25277	See N-65-35410
67370	20-25766	See N-65-35576
67390	20-25789	See N-65-35413
69378	20-25677	See N-66-15458
69380	20-25447	See N-66-15448
69479	20-25383	See N-66-15632
69917	20-25571	See N-66-16152
NASA-SP–	**(Misc.)**	
3024(Vol.2)	20-25989	CFSTI $1.00 cy, $0.75 mn
NASA-TM–	**(Misc.)**	
X-51568	20-25751	See N-65-35246
X-51592	20-24873	See N-65-35317
X-51860	20-25951	See N-65-35269
X-52000	20-25569	See N-65-35213
X-52011	20-25244	See N-65-35248
X-52115	20-26249	See N-65-36897
X-52122	20-25463	See N-65-34908
NASA-TN–	**(Misc.)**	
D-2978	20-25764	See N-65-32965
D-3073	20-25570	See N-65-35957
D-3429	20-25485	CFSTI $2.00 cy, $0.50 mn
NASA-TT–	**(Non-AEC)**	
F-9578	20-25768	For translation see N-65-36757
F-9713	20-25578	For translation see N-65-35787
NBS-Misc.-Publ.–		**(Non-AEC)**
278	20-25722	See NP-15967
NDA–	**(Misc.)**	
42	20-26065	Dep. mn. CFSTI $1.00 cy, $0.50 mn
NDL-TR–	**(Non-AEC)**	
55	20-25374	See AD-631742
NEIC-RR–	**(Polish)**	
17	20-24829	Dep. CFSTI $5.00 cy, $1.00 mn
NLCO–		
957	20-25486	Dep. mn. CFSTI $1.00 cy, $0.50 mn
971	20-25477	Dep. mn. CFSTI $1.00 cy, $0.50 mn
973	20-24977	Dep. mn. CFSTI $2.00 cy, $0.50 mn
NP–	**(AEC File No. for Non-AEC Reports)**	
15656	20-25655	Dep. mn
15915	20-26549	Dep. mn
15919	20-26587	Dep. mn
15950	20-26588	Dep. mn
15963	20-25886	Dep. mn
15964	20-25790	Dep. mn
15967	20-25722	GPO $0.55
15974	20-26253	Dep. mn
16004	20-24978	
16010	20-26345	Dep. mn
16036	20-25321	Dep. mn
16038	20-25245	
NYO–		
72-73	20-26088	DTI Extension
3029-9	20-26026	Dep. mn. CFSTI $1.00 cy, $0.50 mn
3383-3	20-25124	Dep. mn. CFSTI $1.00 cy, $0.50 mn
3406-1	20-25385	Dep. mn. CFSTI $2.00 cy, $0.50 mn
3525-5	20-26183	Phys. Rev., 145: 968-71(1966)
3578-3	20-26254	Dep. mn. CFSTI $1.00 cy, $0.50 mn
3622-2	20-26400	Dep. mn. CFSTI $0.50 cy, $0.50 mn
ORNL–		
3839	20-26089	Dep. mn. CFSTI $1.00 cy, $0.50 mn
3903	20-25197	Dep. mn. CFSTI $2.00 cy, $0.50 mn
3934	20-26090	Dep. mn. CFSTI $2.00 cy, $0.50 mn
3938	20-26255	Dep. mn. CFSTI $2.00 cy, $0.50 mn
3947	20-25487	Dep. mn. CFSTI $2.00 cy, $0.50 mn
3949	20-25619	Dep. mn. CFSTI $3.00 cy, $0.50 mn
ORNL-NSIC–		

Report No.	Abstract No.	Availability
11	20-25322	Dep. mn. CFSTI $4.00 cy, $0.75 mn
15	20-26401	Dep. mn. CFSTI $3.00 cy, $0.75 mn
ORNL-P–	**(Misc.)**	
1203	20-26091	Dep. mn. CFSTI $2.00 cy, $0.50 mn
1459	20-26128	Health Phys., 12: 693-8(1966)
1529	20-26336	Health Phys., 12: 673-81(1966)
1580	20-24914	Int. J. Radiat. Biol., 10: 207-10(1966)
1589	20-26274	J. Appl. Phys., 37: 2182-4(1966)
1667	20-26164	Phys. Rev., 145: 758-65(1966)
1676	20-25501	Electrochem. Technol., 4: 117-20(1966)
1767	20-25735	J. Chem. Phys., 44: 3506-13(1966)
1915	20-25422	Rev. Sci. Instrum., 37: 631-5(1966)
1931	20-25057	Inorg. Nucl. Chem. Lett., 2: 15-18(1966)
2072	20-26092	Dep. mn. CFSTI $1.00 cy, $0.50 mn
2105	20-25386	Dep. mn. CFSTI $1.00 cy, $0.50 mn
2106	20-26093	Dep. mn. CFSTI $2.00 cy, $0.50 mn
2107	20-25268	Dep. mn. CFSTI $1.00 cy, $0.50 mn
2110	20-26153	Phys. Lett., 21: 201-4(1966)
2117	20-26094	Dep. mn. CFSTI $1.00 cy, $0.50 mn
ORNL-TM–		
1401	20-26535	Dep. mn. CFSTI $1.00 cy, $0.50 mn
1501	20-25525	Dep. mn. CFSTI $1.00 cy, $0.50 mn
1503	20-26536	Dep. mn. CFSTI $2.00 cy, $0.50 mn
1510	20-25109	Dep. mn. CFSTI $1.00 cy, $0.50 mn
ORNL-tr–		
1102	20-26099	Dep. mn. JCL $2.60 fs, $1.04 mf
1121	20-25199	Dep. mn. JCL $1.10 fs, $0.80 mf
1144	20-25724	Dep. mn. JCL $1.60 fs, $0.80 mf
1173	20-26514	Dep. mn. JCL $3.60 fs, $1.19 mf
1180	20-25725	Dep. mn. JCL $1.60 fs, $0.80 mf
PAEC(A)PH–	**(Philippines)**	
663	20-25791	Dep. mn
663-a	20-25887	Dep. mn
PAN–	**(Polish)**	**(This series of reports was terminated in 1965. Subsequent reports are identified by the code INR.)**
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1,022,528	20-25176	
1,022,582	20-25364	
1,023,157	20-25542	
1,023,357	20-25213	
1,023,522	20-25214	
1,023,585	20-26408	
1,023,822	20-25543	
1,023,823	20-26452	
1,023,971	20-26453	
1,024,123	20-26454	
1,024,370	20-26409	
1,024,628	20-25775	
1,024,765	20-25482	
1,024,767	20-25238	
1,025,109	20-26455	
1,025,111	20-25433	
1,025,114	20-26410	
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1,025,352	20-25672	
1,025,551	20-26411	
1,025,846	20-25544	
1,026,474	20-26445	
1,026,559	20-26509	
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1,027,078	20-25239	
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723,259	20-26412	
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1,190,224	20-26510	
1,360,279	20-26547	
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1,207,096	20-25507	
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1,207,928	20-25545	
1,208,297	20-25546	
1,208,421	20-25194	
1,208,743	20-25547	
1,209,114	20-25215	
1,209,219	20-25673	
1,209,220	20-25434	
1,209,221	20-26456	
1,209,564	20-25216	
1,209,745	20-25217	
1,210,092	20-25435	
1,210,495	20-26414	
1,210,496	20-26415	
1,210,499	20-26443	
1,210,959	20-26416	
1,210,960	20-26417	
1,211,341	20-25195	
1,211,343	20-25776	
1,211,344	20-26418	
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1,212,050	20-25548	
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1,212,303	20-25549	
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3,222,526	20-25436	
3,234,780	20-25366	
3,235,409	20-25177	
3,235,726	20-25367	
3,236,053	20-26585	
3,236,584	20-25178	
3,236,638	20-25610	
3,236,663	20-25550	
3,236,921	20-25551	
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3,237,009	20-25272	
3,238,014	20-25218	
3,238,105	20-26511	
3,238,288	20-25240	
3,238,369	20-25437	
3,238,370	20-25438	
3,238,414	20-25648	
3,238,574	20-25439	
3,238,797	20-26419	
3,239,306	20-25219	
3,239,307	20-25220	
3,239,334	20-25552	
3,239,663	20-25368	
3,239,667	20-25440	
3,239,668	20-25369	
3,239,669	20-25338	
3,239,707	20-25675	
3,240,678	20-26447	
3,240,931	20-25676	
3,240,937	20-25314	
3,240,938	20-25315	
3,240,939	20-25370	
3,240,940	20-25371	
3,240,971	20-25441	
3,241,230	20-25553	
3,241,909	20-25221	
3,241,955	20-25554	
3,242,333	20-25442	
3,243,257	20-25222	
3,243,280	20-25107	
3,243,289	20-25611	
3,243,290	20-25612	
3,243,291	20-25613	
3,243,348	20-26331	
3,243,349	20-25555	
3,243,350	20-25614	
3,243,351	20-26512	
3,243,588	20-25443	
3,243,590	20-25444	
3,243,613	20-26513	
3,243,793	20-25372	
3,243,954	20-26332	
3,244,475	20-25223	
3,244,882	20-25316	
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Report No.	Abstract No.	Availability
3,249,509	20-25557	
3,250,590	20-25108	
3,251,337	20-25483	
3,251,645	20-25224	
PG-Report–	**(British)**	
692	20-24979	Dep. BIS $0.80. HMSO 4s. 0d.
PNE–		
504F	20-25231	Dep. mn. CFSTI $0.55 cy, $0.50 mn
701F	20-25232	Dep. mn. CFSTI $2.00 cy, $0.50 mn
801F	20-25305	Dep. mn. CFSTI $3.00 cy, $0.75 mn
913F	20-25306	Dep. mn. CFSTI $3.00 cy, $0.75 mn
PPAD–		
583D	20-25387	Dep. mn. CFSTI $1.00 cy, $0.50 mn
PUC–		
937-201	20-25888	Dep. mn. CFSTI $2.00 cy, $0.50 mn
1965-157	20-26137	Nucl. Phys., 77: 1-80(1966)
R–	**(Misc.)**	
66SD19	20-26256	
RFP–		
679	20-25573	Dep. mn. CFSTI $1.00 cy, $0.50 mn
728	20-25036	Dep. mn. CFSTI $2.00 cy, $0.50 mn
RHEL-R–	**(British)**	
108	20-25889	Dep. mn. BIS $1.60. HMSO 8s.
RISO-M–	**(Danish)**	
348	20-26397	Dep. mn
RLO–		
1731-5	20-24831	Dep. mn. CFSTI $2.00 cy, $0.50 mn
1750-4	20-25282	Dep. mn. CFSTI $1.00 cy, $0.50 mn
RM–	**(Misc.)**	
4760-ARPA	20-25303	See AD-626946
RPI–	**(Misc.)**	
328-38	20-26437	Nucl. Sci. Eng., 25: 75-84(1966)
RRL–		
2310-174	20-25125	Dep. mn. CFSTI $1.00 cy, $0.50 mn
RT-FI–	**(Italian)**	
(65)60	20-25723	Dep. mn
SC-CR–		
66-2025	20-26589	Dep. mn. CFSTI $2.00 cy, $0.50 mn
SC-DC–		
66-1414	20-25323	See SC-R-66-865
66-1491	20-25345	Dep. mn. CFSTI $1.00 cy, $0.50 mn
66-1509	20-25574	Dep. mn. CFSTI $2.00 cy, $0.50 mn
SC-R–		
66-865	20-25323	Dep. mn. CFSTI $2.00 cy, $0.50 mn
66-871	20-25346	Dep. mn. CFSTI $1.00 cy, $0.50 mn
SGAE-CH–	**(Austrian)**	
28/1966	20-25478	Dep. mn
SGAE-PH–	**(Austrian)**	
34/1965	20-26095	Dep. mn
SLAC–		
59	20-25656	Dep. mn. CFSTI $3.00 cy, $0.75 mn
SLAC-PUB–		
179	20-25657	CFSTI $1.00 cy, $0.50 mn
SLAC-TN–		
66-4	20-25658	Dep. mn. CFSTI $1.00 cy, $0.50 mn
STI-DOC–	**(International Atomic Energy Agency)**	
10/50	20-26350	IAEA: $6.00; S126,-; £1.16.0; F Fr 24,-; DM 21,-
57	20-26537	Dep. mn. IAEA
58	20-26538	Dep. mn. IAEA
STL–	**(Misc.)**	
8423-6005-RU-000(Vol.1)	20-25276	See N-65-35350
8423-6010-RU-000(Vol.6)	20-25277	See N-65-35410
SU-IPR–	**(Misc.)**	
52	20-26257	
59	20-26258	Dep. mn. CFSTI $2.00 cy, $0.50 mn
SZS–	**(German)**	
2(1966)	20-24980	Dep. mn
TID–		
16764(Suppl.2)	20-25324	Dep. mn. GPO $0.20
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22862	20-24950	Dep. mn. CFSTI $1.00 cy, $0.50 mn
22872	20-24832	Dep. mn. CFSTI $3.00 cy, $0.75 mn
22875	20-25620	Dep. mn. CFSTI $1.00 cy, $0.50 mn
22877	20-24833	Dep. mn. CFSTI $4.00 cy, $0.75 mn
22878	20-24834	Dep. mn. CFSTI $4.00 cy, $1.00 mn
22881	20-26259	Dep. mn. CFSTI $2.00 cy, $0.50 mn
22889	20-26096	Dep. mn. CFSTI $1.00 cy, $0.50 mn
TR–	**(Misc.)**	
65-351-F	20-25617	See N-65-33370
TRG-Inf.Ser–	**(British)**	
518	20-25246	Dep. BIS $0.70. HMSO 3s. 6d.
TRG-Report–	**(British)**	
935(Rev.1)	20-25592	Phil. Mag. (8), 13: 157-66(1966)
1119	20-25037	Dep. BIS $0.50. HMSO 2s. 6d.
TT–	**(Canadian)**	
66-31006	20-25576	See JPRS-34566
UARL–		
E920365-3	20-26254	See NYO-3578-3
UCRL–		
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12336	20-25406	Health Phys., 12: 683-91(1966)
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13204	20-25307	Dep. mn. CFSTI $1.00 cy, $0.50 mn
14314	20-25233	J. Brit. Nucl. Energy Soc., 5: 60-71(1966)
14568	20-26097	Dep. mn. CFSTI $1.00 cy, $0.50 mn
14714	20-25110	Dep. mn. CFSTI $1.00 cy, $0.50 mn
16171	20-25357	Rev. Sci. Instrum., 37: 643-8(1966)
16282	20-25792	Dep. mn. CFSTI $3.00 cy, $0.75 mn
16322	20-25831	Phys. Rev., 145: 766-71(1966)
16539	20-25388	Dep. mn. CFSTI $1.00 cy, $0.50 mn
16708	20-25659	Dep. mn. CFSTI $1.00 cy, $0.50 mn
16724	20-25389	Dep. mn. CFSTI $2.00 cy, $0.50 mn
16726	20-25660	Dep. mn. CFSTI $1.00 cy, $0.50 mn
16777	20-26351	Dep. mn. CFSTI $2.00 cy, $0.50 mn
UCRL-Trans–		
1320	20-25302	Dep. mn. JCL $4.60 fs, $1.64 mf
UNC–	**(Misc.)**	
5149	20-26402	Dep. mn. CFSTI $1.00 cy, $0.50 mn
UR–		
875-115	20-25906	Nuovo Cimento (10), 43A: 33-42(1966)
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1232	20-25479	Dep. mn. CFSTI $2.00 cy, $0.50 mn
USNRDL-TR–	**(Misc.)**	
985	20-25373	See AD-631709
995	20-24973	See AD-632528
996	20-24972	See AD-632283
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